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THE

PSYCHOLOGICAL BULLETIN

LATERALITY OF FUNCTION [1, 2]

BY JUNE E. DOWNEY

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Laterality of function has in recent years been recognized as presenting many problems for investigation, problems much more comprehensive and complicated than were suspected by earlier writers on handedness. In contrast, too, with the older discussions, emphasis is put on factual rather than speculative material and an endeavor is made to measure degrees of functional dominance so as to make possible a statistical handling of the various problems.

Somewhat in line with the traditional treatment is Ingalls' discussion (**48**) of right-handedness in which he states that he believes the problem of why we are right-handed admits of no definite solution and is in any case of no importance, since the real problem is why man is handed at all. Specialization of function, or functional superiority, is one of the economies of nature; handedness is due to cerebral specialization; it is essentially a human characteristic. The latter statement appears dubious in the light of recent investigations on handedness in rats.

Uhrbrock (**104**) has outlined a tentative theory in explanation of handedness in terms of the pressure exerted upon the head of the infant at birth, unequal pressure upon the two sides of the cranium resulting from internal rotation. This theory is submitted subject to future verification or refutation.

[1] A review of papers appearing from 1924 on. A few reports in foreign journals have been omitted because not accessible to the reviewer.

[2] This paper, completed some months before the death of Dr. Downey, has received special editorial attention from Thelma Dreis, Yale University, who has also contributed a supplementary bibliography.

Methods of Testing and Classification

A central problem in recent experimentation is the development of an adequate method of scaling an individual for handedness. Bimanual habits in addition to unimanual habits are also receiving attention.

Questionnaire reports by adults on one's method of distinguishing right from left have a limited value. The question how one tells the right from the left has no meaning at all for certain observers for whom the distinction is too automatic to be introspectible. Others are able to cite definite cues such as feeling of greater tonicity in one or the other hand, or reliance upon some sort of visual cue, as a scar or ring. The presence of definitely recallable cues either for childhood or adult situations is associated with more liability to spatial confusions and points to a less strong handedness bias (Downey, 23).

Woo and Pearson (113) utilizing data in the Galton laboratory for male groups (3,838 to 6,992 cases, six to eighty-one years) and accepting the difference in grip between the two hands as the measure of manual dextrality concluded that lateralism is a continuous variate and that "dextrality and sinistrality are not opposed alternatives, but quantities capable of taking values of continuous intensity and passing one into the other." Woo (114) in a second memoir, used as tests of manual dextrality on about 400 university students, (1) grip, (2) "first and last pull" on a dynamometer, (3) difference of first and last pull, or lack of endurance in pulling, (4) steadiness of hand, and (5) a balancing test. Again, he concludes that people are not dichotomized into dextralists and sinistralists. Dominance of laterality in any of the characters tested was not significantly associated with dominance of laterality in any other character.

Tests utilized by other investigators include grip, steadiness and aiming, dart-throwing, various form-boards (Heinlein, 45, 46; Wallin, 106); peg-board, color-sorting, pink tower, form-boards (Jones, 53); writing, throwing, hammering (Oates, 73). For bimanual activities observations are made on batting, sweeping, raking, spading and shoveling (Downey, 23; Haefner, 43; Oates, 73; Ojemann, 76).

The most elaborate attempts to devise a scale for rating handedness are those of Haefner (43) and Ojemann (75, 76).

Haefner used paired groups of 68 left-handed and 68 right-handed boys and girls in grades 4, 5, 6, and 7. Chronological age, sex and school grades were kept constant for each pair. The following tests were used: Direction of drawing, throwing with one hand,

receiving an object, easy reaching, energetic reaching, thumb on top, use of baseball bat, use of broom. The highest score obtainable was 16. The best index of dominance was found in the throwing activity. The bimanual activities were found to be less significant as indices of handedness than the unimanual activities. Haefner concludes, "Left-handedness and right-handedness are by no means unitary terms but may include, on the contrary, combinations of hand activities which differ almost as widely as do the two terms themselves." Haefner's tests and his method of scoring have been modified and used in the investigations of Cuff (**9, 10**) and Scheidemann (**91**).

Ojemann (**75, 76**) has devised a technique for scoring both unimanual and bimanual handedness. By means of a combined score on five different tests (ball-throwing, paper-cutting, tapping, needle-threading, block-packing) he was able to differentiate between different unimanual handedness groups, namely, the right-handed, the left-handed, and ambidextrous. The judgment of parents concerning the handedness of children was selected as criterion for determining the differential value of a test. The combined scores on the five selected unimanual tests for an unselected group when represented graphically gave a bimodal curve. Ojemann concludes, in opposition to most investigators, that handedness is a general factor which tends to divide individuals into two groups. Relatively few individuals are ambidextrous.

A combined description of the use of the hands in unimanual and bimanual activities is furnished by the so-called handedness formula, Downey (**23**) following Rife. The first letter of the formula is used to indicate unimanual handedness; the second and third letter which hand is down (a) in batting, (b) in such operations as sweeping, spading and the like. Such a formula has descriptive, if no other, value. The resulting formulæ RRR (LLL), RLL (LRR), RRL (LLR), can be modified so as to insure greater accuracy in report. For example, RRR-A might be used to indicate that the hands change position on broom or spade or RRR-Cr to indicate that the work is done on the side of the body opposite to the hand down (Ojemann, **76**).

Some confusion has arisen through interpretation of the formula in a theoretical way, so that the third letter comes to signify the right- or left-handed way of performing rather than the relative position of the hands.

All investigators so far have found that the majority place the

left hand down on the broom and spade.[3] For this reason Ojemann (76) considers this the right-handed way of operating, and exchanges L and R in the third letter of the formula. He finds that bimanual handedness as classified by him varies directly with unimanual handedness.

Some curious discrepancies occur among the various reports on bimanual handedness. Downey (23) found 17 per cent of superior men were left-handed batters and 10 per cent of inferior men. Over 50 per cent of left-handed subjects batted left-handed. Haefner (43) reports 30.9 per cent left-handed batting among his right-handed children and 60.3 per cent among his left-handed. Ojemann (76) found among his 518 young subjects, both right- and left-handed, only 4.6 per cent left-handed batters. Experience and criterion used in classification are no doubt complicating factors.

Smith (97) in commenting on bimanual handedness insists that the conception of nearness "to the business end of the tool" is without value since within a constant hand-position many different movements of the body may be distinguished. These movements may vary qualitatively relative to the nature of the task: in light and heavy sweeping, for example. From her study of the use of the two hands by the blind in reading point-script, Smith suggests that the left hand really functions as a sense organ and that the right hand is superior only as an effector organ.

Woo and Pearson (113) in discussing the conclusions of Van Biervliet have also cautioned against confusion of muscularity with sensitivity in investigations on lateralism.

In connection with bimanual handedness a curious phenomenon known as synergia probably deserves consideration. Pathological cases have been reported in which the movements of the two hands cannot be dissociated. Drinkwater (30) calls attention to the fact that this is the natural condition in infancy; dissociation occurs only as a matter of gradual development.

Orton and Travis (82) question attempts to determine handedness in adults by motor tests since training may obscure the original physiological preference. They have recourse, instead, to precedence of action currents in the forearms during simultaneous voluntary flexion of the digits of the two hands.

Watson (107), reporting on the First Neurological Congress, cites Minor (Moscow) as suggesting an anatomical basis for

[3] The seeming discrepancy in Oates (73) is due to his shift in method of recording bimanual handedness.

discerning handedness, apart from training, in the spread of the veins on the back of the hand. (See Minor, **174, 175.**)

Genetic Studies

Observations on infants and pre-school children are of first importance in determining whether or not functional dominance is native and whether it increases with age. Gesell (**40**) states, "Under extremely diverse . . . social suggestions, we have found that the great majority of infants . . . show a progressive tendency toward right-handedness which becomes well established in the second half of the first year." Under similar conditions a minority of infants show equally well defined left-handedness.

Five hundred observations of handedness preference in infants from 80 to 300 days of age were made by M. C. Jones (**53**). "As part of the routine procedure in testing for thumb opposition and reaching, the reactions of the two hands were noted separately. *At the stage where these functions were developing no preference was found for one hand rather than the other,* except in a very few cases." A left hand dominance occurred in a case of spastic right paralysis; in another, where both parents were left-handed; and in a third case (right-handed parents) in spite of a severe burn on the left hand.

Wellman (**108**) concluded that there was an increase in superiority of the right hand from three to six years; Johnson (**49**) and McGinnis (**63**) have also reported that there is a tendency for older children to use the right hand to a greater degree than younger children.

Heinlein (**45**) reports results on a series of tests including grip, tapping, steadiness and aiming tests given to 60 children from four to twelve years of age. These tests were repeated at yearly intervals for a decreasing proportion of the children. Twenty-five per cent of the group consistently made superior scores with a given hand in repeated trials of all test series. When the children were classified as "consistently right-handed, consistently left-handed and inconsistent" it appeared that the consistently right-handed showed an age increase in dextrality in the tapping and target series; the consistently left-handed an age increase in dextrality in grip and steadiness, but a decrease in the target test. There were no significant age changes in dextrality apparent in the inconsistent group.

Heinlein (**46**) has also reported on preferential manipulation in children of pre-school age. The tests of handedness used were the Dunlap Marble Board, the Cornell adaptation of the Seguin Form Board, and toys. She also investigated learning by the non-preferred

hand, trained left-handed children in the use of the right hand in a coördination test and a dart-throwing test and reported daily observations on uncontrolled activities. Convenience was found to play an important rôle in preferential manipulation of pre-school children. Equal accessibility to both hands leads to the predominant use of the preferred hand and this tendency is more pronounced when objects are conveniently located relative to the preferred hand, with greater variability when the greater convenience exists for the non-preferred hand. It proved possible to train the non-preferred hand in various activities with a transfer to the preferred hand. "The results of the various tests of handedness indicate the existence of 'degrees' of manual bias ranging from a pronounced preference for either the right hand or the left hand to a relatively ambidextrous state where neither hand is definitely favored."

H. E. Jones (**52**) has given an excellent summary of the observations that have been made on handedness in infancy, and also of the changes in quantitative dextrality in relation to age. The latter problem is handled in his own investigation. "The evidence," he writes, is "in favor of an increasing dextral lateralization during infancy, and, less conclusively, up to six years of age. With preadolescents conflicting results have been obtained, while among adolescents several studies have shown that the difference between the two hands is beginning to diminish." But the specific function tested and the method of computing the dextrality index complicate the issue. In Jones' observations on 60 pre-school children the correlations indicate a positive but low relation between dextrality and age. Varying interpretations of the increase of dextrality with age are outlined but with the data at hand the author does not attempt to decide between the origin of right-handedness in environmental or intra-organic influences.

Boynton and Goodenough (**4**) have recorded the posture of 56 nursery school children during sleep and report that these children spent the greatest part of their total sleeping time on the right side with the left side slightly less favored, the abdomen next and the back least. They believe, however, that not right-handedness but other factors operated to produce this result and that, on the whole, there is a slight tendency for the child in whom hand-preference is more strongly developed to sleep on the side opposite to the preferred hand.

Johnson (**50**) in studying changes in muscular tension in coördinated hand movements, using the Dunlap tapping board, found that in terms of four types of pressure records a child's left hand per-

formance might be of a distinctly different type from his right hand performance.

Gordon (**41**), reporting on the hand and eye preference of twelve nursery school children, found that five preferred the right hand and the right eye; five preferred the right hand and the left eye; one preferred the left hand and the right eye; one preferred the left hand and the left eye.

Origin of Handedness

It is a common assumption that left-handedness is inherited but proof of this assumption is a difficult matter. Chamberlain (**6**) reports an interesting statistical investigation which was stimulated by Ramaley's hypothesis that left-handedness appears according to Mendelian law. Chamberlain sought to find families in which both parents were left-handed, using handwriting as the criterion of left-handedness. A total population of 12,068 was interrogated. From families in which one or both of the parents are right-handed he reported a percentage of 17.34 per cent of the children left-handed, while in families in which neither of the parents are left-handed only 2.1 per cent of left-handed children were found. Chamberlain concludes, " There can be no doubt that the trait is inherited, but surely not as a Mendelian recessive."

The recent work on handedness and eyedness suggests the need of investigations in which parents as well as children are scaled in accordance with quantitative tests. Possibly, as has been suggested, the whole problem of inheritance of handedness could be much better approached by way of handedness in rats.

White and Dallenbach (**110**) find that position is a determinant of attention and that the specific positional preference is a matter of the handedness of the O, right-handed O's being predisposed to the left and left-handed O's to the right. This confirms the earlier investigation of Burke and Dallenbach.

Gesell (**40**) believes that the evidence at hand favors the view that handedness is due to germinal factors but the evidence is not conclusive because " sinistrality may still be a secondary by-product of a more fundamental familial trait involving vascular or anatomical peculiarities. The frequency of left-handedness in twins suggests an epigenetic factor of a regulatory nature."

As a test for monozygotic or identical twins several authorities have suggested the use of finger, hand and sole prints and concluded that the same hands or feet of the two individuals are more nearly alike than the different hands or feet of the same individual.

Newman (71) says "that a great majority of the unequivocal cases of identical twins exhibit same-sided asymmetry, the right side of one twin being more like the right side of the other twin than like his own left side. Also, usually, the left side of one is more like the left side of the other than like his own right side. This rule holds true especially in the most strikingly similar twins. In the less strikingly similar, yet unequivocal cases of identical twins, the right side may be like the right, but the left side may not be any more like the left than like his own right side. In still other cases of certain identicals, especially in those pairs in which one twin is left-handed, the left hand of one twin is more like the right hand of the other twin than like his own right hand."

If, as Newmann believes, left-handedness is inherited as a Mendelian recessive, how can it happen that monozygotic twins, of identical heredity, should so often show reversed handedness? Newman (70) explains this in terms of his theory of epigenetic left-handedness. He assumes that in twinning the inferior side is an asymmetry opposite to that of the superior side and that the twins are genetically right-handed. The epigenetic left-handedness is a somatic variation. He gives as a reason why not all identical twins show asymmetry reversal in one twin the fact that the epigenetic establishment of asymmetry may sometimes take place before twinning, sometimes after. The twins will show a high degree of asymmetry reversal if the establishment of asymmetry takes place before twinning; they will show the same asymmetry if establishment of asymmetry follows twinning. Reichle (88) finds Newman's explanation of epigenetic handedness questionable. (See also Wilson and Jones, 218).

Influence of Training

The influence of training both general and specific upon handedness performances has not yet received the detailed attention it deserves. In particular, it introduces a margin of error in scaling individuals relative to degree of unimanual expertness. Bowman (3) gave a practice series of thirty-five sets of pegging tests (three trials to a set) to five subjects whose handedness habits had been investigated by Downey. All right-handed S's show a decrease in R/L ratio; there was an increase in this ratio for the left-handed. The most significant items in the report are the comparative practice curves of the most right-handed subject R (RRR Right-eyed) and subject D (RRL_3 Left-eyed). At the close of the practice series R's right hand was still outstandingly more expert; D's left-hand

performance, on the contrary, gained relatively more than the right. At times it equalled the right-hand record.

It would, perhaps, be an unattainable council of perfection to insist upon a comparison of right- and left-hand performance in any particular test only after an approximate limit of practice effect had been reached by the two hands. But it is quite likely that such procedure would increase the number of subjects who are rated as ambidextrous. It may be that the one-sided practice of the right hand (or the left hand for the left-handed) operates to produce Ojemann's bimodal curve of unimanual handedness (**75**). Ewert (**33**) in a repetition of Starch's mirror-drawing experiment and an extension of it to include studies of groups as well as individuals reports "the relative ability of the preferred and non-preferred hand to improve in mirror-drawing is about equal for both hands." However, no comments are given which enable one to judge the basis on which the two groups using respectively the non-preferred and the preferred hand were selected. Coons and Mathias (**7**) report an experiment enforcing subjects with right monocular preference to use the left eye. They conclude that ocular dominance may be acquired through use or lost through disuse. They give no details relative to their experiment.

Griffith (**42**), using ten tests of motor ability, concluded that "with five of the eight tests with which both right- and left-handed scores were obtained, there was a greater gain in the scores for the preferred hand than in the scores for the other hand. . . . There is a slightly higher correlation between the scores for the right and left sides in the results for the second day than in the results for the first day. The average dextrality index is slightly greater for the second day's results than for the first day's results. This difference, if not due to chance, means that the right-handed are more right-handed the second day than they are the first." Munn (**68**), reporting an experimental investigation on bilateral transfer of training found the average amount of transfer to left hand due to practice with the right hand was 32.59 per cent.

Everyone is acquainted with cases of left-handed children who use the right hand in writing either under compulsion or because of imitation. The reverse situation in which a right-handed child becomes accustomed to writing with the left hand is less frequently observed. That such cases exist, and perhaps more frequently than we have been accustomed to believe, is evidenced by a curious situation reported by Scheidemann and Colyer (**94**). In a second grade group of 34 children, 16 were left-handed writers. When given a

number of hand preference tests and when tested for ocular dominance ten of these children proved to be definitely right-handed and right-eyed. All but one were shifted without difficulty to writing with the right hand. Both the first and second grade teachers of this group of children were left-handed. Individual case studies (95, 143) suggest that imitation of a left-handed mother, teacher, or companion or even trivial factors may be responsible for unnatural hand preference in writing.

Morsh (67) has reported an experimental study of two left-handed children to whom right-hand training was given in tracing, dart-throwing, mirror-star tracing, and writing, with marked improvement and no bad consequences.

Uhrbrock (103) has summarized the newer points of view concerning handedness for the teacher who is confronted with the problem of deciding whether or not to shift the child writing with the left hand to right-hand writing. An excellent practical discussion of the whole problem of the left-handed child is contributed by Scheidemann (93).

Ocular Dominance

Since Parson (83) formulated his hypothesis that the preferred hand is determined by the sighting eye, a great deal of work has been done on eyedness and its relation to handedness. This work has shown three main tendencies: (1) an attempt to improve the technique by which ocular dominance is determined; (2) an endeavor to classify as accurately as possible in terms of the chosen technique the various forms of eyedness and to determine percentages of frequencies; (3) an effort to recheck the relationship between the various forms of ocular and manual preference. Parson's instrument, first named the manuscope and then renamed the manuoptoscope, was early subjected to certain forms of criticism. Cuff (9, 12), particularly, entered upon a detailed criticism in terms of the inadequacy of the directions for giving the test, and the failure to secure adequate control. Modifying Parson's instrument, he has invented an instrument he calls the manoptometer (11), which consists of an easel and a sighting tube. He describes it as follows (9): "The exposing device has separate slides which are moved in a chance order toward the center of the easel. The back of the easel is divided into centimeters; this makes it possible to secure a quantitative measure of the unilateral sighting tendency as an index of handedness." The advantage of Cuff's instrument is the possibility of stating data in

quantitative terms. Unilateral sighting preference may be much stronger for one right-eyed individual than it is for another.

Lund (**62**) describes a new device, the monoptometer, which he considers superior to other proposed devices for measuring eye-dominance. It makes use of more objective and less artificial conditions, does not rely upon S's report, and yields quantitative results as regards both kind of dominance and degree of dominance.

Mills (**66, 173**) used divergence inside of the convergence near point as a test for ocular dominance. Lineback (**59**) reports a method of determining ocular dominance by the position of the shadow of a staff placed in right angle line with a spot on a wall some 16 feet distant and about 4 feet away from the subject. A. M. and M. A. Snyder (**98**) use a projection test. "It consists in fixating a designated point on the test card and, without moving the eyes, bringing the top of a pencil or the point of the finger in line with the line of sight about midway between the card and the eyes. As either left or right eye is closed the results are noted and interpreted according to the information contained on the card." Scheidemann (**92**) describes a simple peep-hole test that can be used with children.

Miles (**64, 65**) has reviewed various tests for ocular dominance that have been suggested as (1) Comparative Monocular Brilliance; (2) Comparative Monocular Acuity; (3) Comparative Fixedness of the Visual Image When the Eyes are Alternately Covered; (4) Comparative Persistency in Convergence; (5) Unilateral Sighting. He has also described a new vision test named the ABC Vision Test (**172**). Specially prepared test cards are viewed through a paper funnel or V-scope that is made of folded white cardboard, formed in such a manner that it must be pressed open between the two hands if the subject is to see through the aperture. Standard directions for giving the test are employed. Miles has obtained photographs of groups, each member of which is provided with a V-scope so focused as to show clearly ocular dominance.

Updegraff (**209, 210**) has used the Miles ABC Vision Test with children from two to six years of age. Scheidemann and Robinette (**199**) were able to test ocular dominance in children as young as twenty-one months of age by use of the peep-hole test.

Downey (**27**) has checked on successes of observers in judging ocular dominance from ordinary photographs. Observers range in accuracy from 48.2 per cent to 62.9 per cent. With selected photographs it was possible to obtain an accuracy of 76 per cent for a group of observers.

Danielson (**16**) has extended the research investigation carried

on forty years ago by the Riders on unilateral voluntary winking. The Riders were concerned mainly with the influence of relative visual acuity on the winking habit; Danielson worked with ocular dominance and many other conditions. About 500 patients were studied. Moving pictures were taken and cuts made to illustrate different types of winking ability and their relation to facial grimaces. A great deal of valuable material was collected. Briefly, Danielson concluded that "The dominant eye is the contralateral to the better winking eye in most cases."

It is interesting to compare the percentages for eye preference cited by different experimenters. Parson (**83**) reported 69.3 per cent right-eyed, 29.3 per cent left-eyed, 1.37 per cent impartial vision. Downey (**23**), using Parson's manuoptoscope and Wray's ring test, reported about 73 per cent right-eyedness among right-handed men and 64.6 per cent right-eyedness for right-handed women; Cuff (**9**), using Parson's instrument, found 62.3 per cent right-eyed, 28.8 per cent left-eyed and 8.9 per cent impartial in vision. Using his own manoptometer, he (**12**) reported that four groups of eyedness should be recognized: the right-eyed, the left-eyed, the unstable-eyed, and the equal-eyed. His percentages were: right-eyedness, 72.9 per cent for 120 boys, 70.6 right-eyedness for 117 girls. Miles (**64**) reports for various groups of subjects, both children and adults, that for normal population about 65 per cent will demonstrate dominance of the right eye, 30 per cent dominance of the left, and 5 per cent mixed or impartial vision. A. M. and M. A. Snyder (**98**) report that on the average 64 per cent have a right monocular preference and 21 per cent have a left monocular preference which makes a total of 85 per cent who have a distinct eye preference. They also believe that eye preference is an acquired visual habit, is modifiable, and varies in degree with age.

Lund (**62**) reports that his monoptometer tests yielded 69.8 per cent right-eyed, 25.5 per cent left-eyed, and 4.6 per cent binocular and ambiguous.

Determination of amount of manual and ocular asymmetry has proved of great interest. Later investigators agree that Parson begged the question by his assumption that whenever he found a discrepancy between eyedness and handedness either eye or hand preference had been interfered with. Cuff (**9**) reports that using Parson's instrument and giving the test five times in succession he found that the exceptions to Parson's "theory of handedness as a result of eyedness amount to approximately 20 per cent of the number tested." Miles (**64**) quotes with approval Enslin's conclusion

that "the clearly left-handed are about evenly divided between left- and right-eye dominance, whereas in the right-handed the great majority are right-eyed."

Downey's (**23**) figures lead to much the same conclusion, although she found more eye- and hand-asymmetry for inferior than for superior right-handed men, and some indication of a sex difference in eyedness apparently not confirmed by other investigators. Oates (**73**) reports for a selected group of 194 left-handed boys that 52.6 per cent were right-eyed and adds, "From our table it appears that there is an increasing amount of crossed sinistrality in the mixed sinistral types, and that it is least in the pure sinistral groups."

Comparative Visual Acuity

The problem of the comparative acuity of the two eyes should not be confused with that of ocular dominance in sighting; although apparently many persons assume that the more acute eye will be the sighting eye.

Woo and Pearson (**113**), conceiving ocular dextrality in terms of the difference in visual acuity of the two eyes, found, in the Galton data, no correlation between manual and ocular dextrality. Ocular lateralism, as manual lateralism, was found to be a continuous variate. They found no correlation with age. These conclusions were confirmed by Woo's second investigation (**114**) on a group of 400, and with an increased number of tests of ocular superiority.

Cuff (**9**) reported lack of agreement between acuity and manuscopic tests. Geldard and Crockett (**39**) after a carefully controlled experiment on binocular acuity concluded that "the difference between the eyes with respect to visual acuity is a function of age." Cases occur in which there are no differences at any age, but such differences become less frequent with increasing age. They report that they failed to find any support whatever for the conception that eyedness and handedness were intimately and positively correlated. No report is given as to how their subjects were classified for handedness and apparently no tests of sighting habit were given. A. M. and M. A. Snyder (**98**) report that eye preference is not necessarily caused by the inferiority or superiority of one eye. They found the preferred eye the weaker in many cases and suggest that possibly in some cases the greater weakness of the preferred eye is a resultant of eye preference. Coons and Mathias (**7**) report that "visual acuity apparently does not determine the eye preference." They tabulated the Snyder test for near- and far-sightedness against

their data for left-monocular, right-monocular, and ambi-ocular preference, but give no details concerning the experiment.

Footedness

Very little work has been done on this topic. Schaeffer (90) concluded from a study of the data at hand that the right leg is longer in about 52 per cent of humans. Lund (61) measured the length of the legs as a test of dominance and reported 39 per cent of left-dominance, 33 per cent of right-dominance, and 28 per cent of equality. If one can infer functional dominance from structural dominance, left-footedness is much more common than left-handedness. Crossed asymmetry, that is, longer arm on the one side associated with longer leg on the other has been reported as common by a number of anthropologists. Downey's figures (23) seem to indicate that the hand down on the spade follows the spade foot. In such bimanual operations as spading and shoveling footedness certainly deserves consideration.

Lund (61) believes correspondence between functional and structural dominance the simple and natural explanation for the typical veering from a straight course that results when a man attempts to walk such a course blindfolded. In a carefully planned experiment on 125 subjects, measurements were obtained for handedness, eyedness, length of arms and legs, and posture and the degree of correspondence with right or left veering calculated. A superior structural development of the right leg in left veering subjects, and *vice versa,* was found in " four out of every five subjects."

Haefner (44) has recently reported on the hand and foot tendencies of children. Four foot tests were used, namely: stepping off, stepping up, kicking, and pressing down with the foot on a wad of paper. These were given to 136 children, of whom half were left-handed. He reports that only a small percentage of children show foot dominance and coefficients between hand and foot tests were likely to be low. The unimanual activities are rather highly correlated with the foot activities of kicking and pressing down but show the results of considerable modification in their relation to the foot activities of stepping off and stepping up. Unimanual activities show a somewhat higher degree of correlation with foot activities than do bimanual activities. Haefner used his test of pressing down to provide a measure of the spade foot, a somewhat dubious assumption.

Thumb on Top

Tabulation of cases shows that in clasping hands with fingers interlocking the right and left thumbs are placed uppermost in a proportion of about 50–50. This 50–50 proportion should not, however, be interpreted to mean that the thumb uppermost is a matter of acquired habit. Downey's (23) figures, in which results from 589 right-handed men were set over against those from 143 left-handed men, showed that while 51.3 per cent of right-handed men have the right thumb up, only 37.1 per cent of left-handed men have this thumb on top. For 374 right-handed women the per cent with right hand up is 57.2 per cent; for 99 left-handed women, 46.4 per cent. Haefner (43) found 52.9 per cent of his 68 right-handed children and 35.3 per cent of his left-handed children placing the right thumb on top.

Handedness and Ability

Wilson and Dolan (112) have attacked by a statistical procedure the question of the relation of handedness and ability. In a preliminary survey they obtained the incidence of handedness among 2,328 junior high school pupils and found, in addition, the percentage of those who had been changed in handedness; the combined percentages gave 9.85 per cent for the boys, and 6.76 per cent for the girls. A comparison was then instituted for the amount of left-handedness in regular rooms and in special rooms for retarded and subnormal children. The percentage in this latter case was 6.37 per cent as against 3.54 per cent in the first case. When classes sectioned for ability were compared it was found that the combined percentages of changed and unchanged left-handedness were 6.60 for the high sections and 10.04 for the low. A study was made of the relationship of handedness to ability in 975 children ready for promotion to the seventh grade. "(a) When intelligence and mean achievement of the sinistrals and dextrals were compared, it was found that the dextrals were slightly superior in every respect. (b) When the two groups had been equated in intelligence the relative superiority of the dextrals in achievement remained approximately the same. (c) When handedness was correlated with intelligence, achievement and chronological age, a superiority of the dextrals was shown to be consistent throughout, although the coefficients were very low. (d) Sinistral girls were slightly superior to sinistral boys in every respect."

Haefner (43) reports for his paired groups of right- and left-

handed that there is found no reliable difference between the two in mean I.Q., in standard deviation of I.Q., or in coefficient of variation of I.Q. No difference was found in school achievement. School grade was held constant for these pairs. As measured by a somewhat crude instrument, the left-handed group seemed to be slightly better adjusted to the school situation than was the right-handed group.

Oates (**73**) concludes, " While sinistrality is apparently not correlated with either superiority or inferiority of intellect, marked departure from unilateral functioning is definitely related to complications in the nervous organization which may hinder the adjustments necessary for the attainment of school efficiency at the level of native ability." Oates, in contrast to the two preceding investigators, reckoned with both manual and ocular dominance.

Lateralism and Speech

The belief that reversal of the native handedness in writing may cause a speech defect is fairly wide extended. There are, however, many dissentients. Elder (**31**) sees no danger in such reversal. Wallin (**106**) writes, " Our figures show that the vast majority of our left-handed pupils who have been taught to write with the right hand have not developed any speech defects." Fletcher (**35**) concludes, " There is indeed an increasing amount of evidence against the hypothesis that there is any unique significance in the act of learning to write with the right hand." Haefner (**43**) reports that his study offers only slight evidence of a relation between change of writing hand and speech defects.

Ojemann (**74, 77**) found that the left-handed child can be taught to write with the right hand without causing any disturbances in speech. In his group of 23 dextrosinistrals, very carefully chosen by application of his scale for determining degree of handedness, the shift from the left to the right hand occurred after the speech habits had become well organized. He recognizes the possibility that in training a left-handed child to write with the right hand certain other factors may produce a speech disturbance; if, for example, the teacher employs a method of training that produces mental confusion on the part of the subject. Ojemann also found no significant differences in the proportions of unimanual or bimanual left- or right-handedness or of unimanual ambidexterity in a comparison between a group of speech defectives and an unselected group. Crossed asymmetries are not discussed by the authors mentioned above.

Oates (**73**) found a higher percentage of speech defects among left-handed than among right-handed children, a proportion increased

in mixed handedness groups and in those where crossing of eye and hand occurred. He concludes, "The tendency to speech disturbance is fundamentally related to departure from unilaterality of function in the native organization of the nervous system which expresses itself in mixed handedness and crossing between hand and eye."

Orton and Travis (82) sought a method of determining the natural physiological bent "after the person had been exposed to a variety of chance and determined factors of motor training." They made a study of the neuromuscular action currents of voluntary contractions in a group of normal speakers and a group of stutterers, and concluded that "the precedence pattern of the action currents in stutterers who use the right hand by preference in trained motor acts varies strikingly from that of normal speakers who have the same right-handed preference." Travis and Herren (101) in a study of simultaneous antitropic movements of the two hands also found differences between right-handed normal speakers with a history of right-handedness, right-handed normal speakers with a history of left-handedness, and left-handed normal speakers with a history of left-handedness. They found also "a significantly greater number of amphiocular persons among the right-handed stutterers than among any other group with the possible exception of the right-handed normal speakers with a history of left-handedness." In a mirror-tracing experiment reported by Travis (99, 207) right-handed stutterers were found to be more facile with the left hand than the right, and right-handed normal speakers more facile with the right than with the left hand. More left-eyed individuals were found among right-handed stutterers than among right-handed normal speakers.

A most interesting case-study of recurrence of stuttering (after 13 years) which followed a shift from normal to mirror-writing is also reported by Travis (100).

Johnson (51) has furnished a study of his own experiences as a stutterer. He ascribes his defect to the fact that he should have been left-handed as shown by the Iowa diagnostic laboratory tests and reports improvement from building up a habit of using his left hand, thus establishing, as he believes, a dominant motor lead.

Lack of Unilateral Dominance and Special Disabilities

Failure in establishment of a dominant unilateral lead has been held responsible not only for speech defects but also for reading, spelling, and writing disabilities. (Orton, 79, 80, 81, 181, 182, 183, 184; Dearborn, 17, 18, 60; Gates, 37; Kingman, 54; Travis, 100.)

Case studies originating from dextral training of left-handed children have been cited by Fagan (34) and Richards (89).

"If," writes Orton (80), "there should be failure in establishment of the normal physiological habit of using exclusively those [engrams] of one hemisphere there might easily result a confusion in orientation which would exhibit itself as a tendency toward alternate sinistrad and dextrad direction in reading and in a lack of prompt recognition of the differences between pairs of words which can be spelled backwards or forwards. . . ."

Dearborn (18) also relates reading and spelling difficulties to interference with the natural movements of eye or hand. He cites cases of reversal of letter-form, tackling words from the wrong end, and partially or completely mirrored-writing as "due to the interference of sinistral tendencies of hand and eye with the learning of the dextrad movements and sequences required in our reading and writing." He found difficulties especially in children who had been changed over in handedness or whose one-sidedness had never been well established. (See also Kelly, 162.)

Payne (84) warns against an indiscriminate application of such theories and shows that often mispronunciations which on the surface may appear to be due to left-handedness and left-eyedness or to disorders in visual functioning are more satisfactorily explained in terms of factors which are characteristic of the normal learning process.

Travis (100) has reported a case of extreme writing illegibility which was helped by a shift to mirror-writing. This patient belonged to a family a number of whose members showed striking writing disabilities. He was ambidextrous and had left-eye dominance. Action currents showed that he lacked a preferential unilateral manual lead.

Mirror-writing has been found associated with reading disability; in part they are thought to have a common etiology (60, 79). Downey (26) has shown that back-slanted writing when produced by right-handed penmen is commonly an indication of left-eyedness or some form of latent sinistrality and that right-handed persons writing mirror-script for experimental purposes commonly slant it in a forward direction. Blom (1) has summarized the literature on mirror-writing and its relation to laterality of function.

On the basis of detailed studies of seven typical cases of individuals showing spontaneous mirror-writing Carmichael and Cashman (5) conclude that the phenomenon of mirror-writing is important not only because of its significance in the problem of handedness

and as a clinical symptom but also because it may yield new insight into the fundamental psychology of the acquisition of motor and perceptual habits. Reproductions of mirror-writing by their subjects and other illustrations give great value to this report.

A comprehensive treatment of mirror-writing from many angles is contributed by Critchley (**8**). He believes it to be physiologically normal for the left-handed person. He discusses also the curious anomaly of "*écriture en double miroir*" and "Senkschrift" or vertical writing as practised by the left-handed. The latter, he thinks, is probably "a compromise between ordinary dextrad writing and mirror-script." Critchley also sketches the problem of orientation of written languages, and concludes that it "lies even deeper than a question of handedness and depends upon those totally unknown factors which determine the 'eyedness' of races and individuals."

In addition to such specific symptoms as slow speech, stuttering, mirror-writing and dyslexia, Wile (**111**) has studied the results of conversion "from right-handedness to left-handedness" in terms of consequent awkwardness, poor muscular coördination, irritability, restlessness, slow thinking and confusion. Feelings of inferiority and general behavior maladjustments are also found so originating. Five groups of left-handed are discriminated.

Lateralism and General Psychopathic Tendencies

Suggestions have been made that crossed dextrality or sinistrality may be connected with general neurotic tendencies. Downey (**23**) raised the question specifically in connection with groups of subjects, but was unable to do more than suggest possibilities in the way of experiment. Estabrooks and Huntington (**32**) attempted to determine the relation of left-handedness to psychoneurotic traits and to introversion by correlating scores for 280 Freshmen on the Colgate test B–2 and C–2 with degree in strength of one hand over the other as determined by the use of the dynamometer. Their results were negative. (See also Gordon, **150**.) So, too, were results obtained by Wetmore and Estabrooks (**109**) when mean scores on Laird's Personal Inventory B_2 for 62 students either totally left-handed, ambidextrous, or having left-handed tendencies were compared with mean scores obtained from 62 right-handed men chosen at random. Cuff (**10**) asks very specifically the relation to psychopathic tendencies of (1) eyedness; (2) handedness; (3) lack of harmony between preferred eye and hand. (1) He tested 203 children in grades three to eight, using three tests of eyedness, nine for handedness, and the Woodworth-Cady questionnaire for psychopathic tend-

encies. Correlations were found for the degree of excess in strength of the tendency to sight with one eye over the other and scores in the Woodworth-Cady questionnaire. Three of the seven correlations were negative, and some of them not four times their probable error; the more reliable r's, however, apparently show that those who have a strong unilateral sighting tendency are the ones who are more nearly normal emotionally. Data not presented in detail suggested that an individual who sights with one eye and winks the other is likely to have fewer psychopathic traits than one who winks and sights with the same eye. Correlations were worked for scores on Haefner's handedness scale and on the psychopathic questionnaire. The results were inconclusive, as were those found for lack of harmony between preferred eye and hand and a psychopathic organization. Some of the results were, however, distinctly promising. Oates (**73**) reports what he considers good evidence of nervous disability in "crossed" groups as compared with pure groups.

Quinan (**86**) has reported figures based upon observations on variously constituted groups as to the extent of visuo-manual symmetry and asymmetry. Handedness was determined by noting the arm used in throwing and eyedness by a sighting test. He concludes that there is a marked tendency for sinistrals, either pure sinistrals or crossed sinistrals, to concentrate in certain of the esthetic vocations and that they are more definitely musical in their tastes than are dextrals. He found in his survey of 693 neuropsychiatric patients that the percentage of sinistrals was 30.4 for dementia praecox patients and 54.1 for a mixed group of persons with constitutional psychopathic states. He believes that sinistrals, especially those who are right-handed and left-eyed, are apt to show signs of constitutional instability.

Quinan (**87**) has also checked the handedness and eyedness of speeders and of reckless drivers. He found that the RL percentages were 26.8 and 45.4 respectively for 354 speeders and 121 reckless drivers. Among 2,331 university students 19 per cent were RL sinistrals. 6.7 per cent of the speeders and 5.7 per cent of the reckless drivers were left-handed men, that is, LL plus LR.

Structural Asymmetry

The relation between structural and functional asymmetry is uncertain.

Smith (**96**), accepting as a criterion of right- or left-handedness the observation "whether the right or left humerus is longer or stronger," reports that left-handedness may be told from fossilized

skulls by the reversal of the normal asymmetry of the brain case, a reversed asymmetry found by investigation to be associated with a longer and more robust left humerus. (See Cohn and Papez, 138.) He cites numerous anthropological authorities and writes "looking through any extensive collection of measurements of human skeletons it will be found that the means of the lengths of the right humerus are definitely greater than those of the left." This is true although Gaupp's summary calls attention to the fact that at time of birth the length of the two bones is identical.

Schaeffer (90) has summarized the not inconsiderable material relative to structural asymmetry so far as the measurement of the length of bones on the right and left side is concerned. He concludes that the results indicate that the left arm is longer in about 9 per cent and the right in 75 per cent and that in comparison with the smaller per cent of those who are functionally left-handed this indicates the effect of early training on handedness. Schaeffer, whose interest in bilateral asymmetry was motivated by his study of spiral movements in man, concluded that there is no definite relationship if any between right-handedness or left-handedness or asymmetries of legs and the dominant way in which the individual turns in walking blindfolded. "The spiraling mechanism is more deep-seated and is demonstrably present in more of the protoplasm of the body than is right-handedness or left-handedness."

Lund (61) combats vigorously Schaeffer's conclusion and finds structural asymmetry the natural explanation of functional asymmetry. He cites in evidence his own experiment on veering already discussed in which he found a structural and functional correspondence in 80 per cent of his cases.

Ide (47) reports on characters shown by the cross-sections of the median and sciatic nerves of human males according to race and states that there is an asymmetry in the size of these nerves according to side. The right nerves are more often larger in the whites, the excess being more marked in the median than in the sciatic nerves. The left nerves are more often larger in the negroes.

Bonnevie (2) in her extensive statistical investigation of finger prints from 24,518 individuals found that there were certain peculiarities in the distribution of pattern types between right and left hands. Whorls were considerably more numerous on right hands; arches and ulnar loops on the left. She also found certain differences when each finger was considered separately, the most outstanding difference being the surplus of whorls upon right hands as concerned with the left ones for digit five, and the high percentage of radial loops on

digit five of the left hand, where their value on the left side is more than 18 times that on the right. In Bonnevie's investigation no selection of cases was made on the basis of handedness. Downey (**23**) has reported finger print patterns for 96 left-handed individuals and found some interesting reversals in percentages. The number of cases is too small to warrant any conclusions, but suggests a promising line of investigation.

Cummins and Midlo (**14**) in their work on palm prints state that their results show clearly the recognized ascendency of the right hand in the position of a more radially extended transversality.

In a later study Cummins, Lecke, and McClure (**15**) analyze the palmar dermatoglyphics of 300 individuals for bimanual differences and report statistics as to a great variety of details. Among other details they state "that right hands are characterized by transverse alignments extending farther both radially and proximally than in lefts, in which the contrast is exhibited by configurations which are more inclined toward the longitudinal." Lecke (**58**) continuing the investigation has compared the palmprints of 244 individuals of determined left-handed traits with the random group of 300 and concludes:

"The relationship of the dermatoglyphic characters to the functionally dominant hand or side is yet indefinite. There are bilateral asymmetries in the arrangement of the configurations which may be designated dextral or sinistral traits. Reversals or suppression of certain of the characteristics occur with functional dominance of the left hand in the mass analysis, though it is yet to be proven whether these reversals will apply to the individual cases. In view of the early fetal elaboration of the dermatoglyphics in their definitive form, the present findings suggest that handedness is innately conditioned, the dermatoglyphic unlikenesses being supposedly an expression of developmental asymmetry underlying the prospective functional dominance."

Lineback (**59**) raises the question of the structural ground-work of visual inequality. Comparisons were instituted between the two eyes of the same individual or animal, careful measurements being "made relative to the position of each macula in regard to its optic-nerve disc. . . . In every one of the eighteen pairs of human eyes the distance was shorter in the right eye than in the left eye. . . . Similar measurements applied to the nine pairs of monkey eyes showed very strikingly similar results; eight of the nine pairs of monkey eyes showed the right macula closer to its respective nerve than the left macula to its disc." This structural condition of

the macula is in harmony with the findings in the acuity tests since it would appear that such adjustment would have some influence in bringing the right eye more readily into the line of vision. Lineback apparently considers ocular dominance and ocular acuity as identical phenomena.

Animal Studies

The complications that exist when humans are tested for laterality of function make it difficult to reach conclusive results. It is probable that more satisfactory observations will follow from investigations on animals, investigations carried out with greater precision and under more perfect control than is possible with human subjects.

Yoshioka (**115**) in 1928 concluded from his experiments on thirty male rats, that in a T-maze where both paths—right and left—were open, rats tended to go toward the right or left when their nasal bones were curved toward the right or left respectively in reference to the long axis of the skull. This conclusion was confirmed in 1930 by results with a different type of maze—the diamond maze (**118**). While group means failed to show any significant preference of one path to the other, individual records were significant. Eleven rats chose the right path predominantly, seven chose the left, ten were neutrals. "When the skulls were prepared and the deviation of the median suture of the nasal bones from the anterio-posterior axis was measured in angles, the correlation between the skull measurements and the choices of right path was found to be $0.69 \pm .066$." In his previous study the correlation was less—$0.432 \pm .148$. The rôle of other forms of anatomical asymmetry in producing a position habit was investigated, but inconclusively. A slight difference in length between right and left ulna and radius was found for eight out of twenty-eight rats.

Yoshioka (**117**) has also tested 100 rats for handedness using a specially devised food pan. A distribution showed about an equal number of right- and left-handers and a small percentage of ambidextrous rats. When the rats were killed and the bones of the four limbs cleaned and measured under a low-power microscope there was found to be a slight association between the longer bones of a dominant arm and handedness. The association may not be significant. Somewhat similar results were reported for 200 rats also tested with the food pan (**116**). It is concluded that in a random sampling of laboratory rats a very few are likely to be ambidextrous and the rest divide themselves about equally to right- and left-handers. A pref-

erential use of one hand may have originated in part at least from a better development of that hand and arm.

Tsai and Mauer (**102**) have also published results of investigations in handedness of rats. They made use of a glass bottle containing food, the opening of which was so small that it permitted the rat to use only one hand at a time in getting food out of the container. Two hundred fifty observations were made on each of 105 normal animals and on 54 vitamin B depleted animals, fairly evenly divided as to sex. Any rat using the left or right hand from 75 to 100 per cent of the total of 250 attempts was considered to be left-handed or right-handed, as the case might be, while any rat using either hand from 50 to 75 per cent of the total attempts was classified as ambidextrous. The majority of normal rats of either sex were found to be right-handed. The percentage of left-handedness was found to be higher among the vitamin B depleted animals, whose maze learning ability was much inferior to that of the normal rats.

Following the suggestions and methods of Yoshioka and Tsai, Peterson (**85**) determined by a feeding test the handedness of seven rats in the given situation; four were predominantly right-handed, two predominantly left-handed, and one ambidextrous. The rats were then operated upon, a portion of the cortex in the hemisphere opposite to the preferred hand being removed; for the ambidextrous rat the left cortex was chosen since the right hand was used most frequently. After a recovery period, observations on the handedness of the rats in the feeding situations was again undertaken. In the case of five of the rats there occurred a definite transfer to the hand opposite to the one normally used. The ambidextrous rat also shifted from the previously favored hand. In one case there was, in time, recovery after the operation. The author interprets the results in terms of preferential and not restricted use of the hands since no paralysis was detected.

The extent and severity of the lesions were next determined and the conclusion reached that "dominance in handedness in the rat, as determined in our feeding situation is dependent on intact motor and somaesthetic fields on the opposite cerebral hemisphere, and that extensive injuries to these fields will lead to a permanent use of the other hand."

Dennis (**20**) has reported briefly on sidedness in sleeping position for two squirrels and thirty-six cows. One of the squirrels was left-sided. For the cows the percentages of sidedness ranged from 50 to 70. Only four of the percentages were reliably different from

50 per cent. "Thus sidedness in sleeping position is found in some but not all of the animals studied."

BIBLIOGRAPHY

1. Blom, E. C., Mirror-Writing. *Psychol. Bull.*, 1928, **25**, 582–594.
2. Bonnevie, Kristine, Main Results of a Statistical Investigation of Finger-Prints from 24,518 Individuals. *Eug., Genetics and Family*, 1923, **1**, 200.
3. Bowman, Hazel, The Effect of Practice on Different Dextral Types. *Amer. J. Psychol.*, 1928, **40**, 117–120.
4. Boynton, M. A., and Goodenough, F. L., The Posture of Nursery School Children During Sleep. *Amer. J. Psychol.*, 1930, **42**, 270–278.
5. Carmichael, L., and Cashman, H., A Study of Mirror Writing in Relation to Handedness and Perceptual and Motor Habits. *J. of Gen. Psychol.*, 1932, **6**, 296–329.
6. Chamberlain, H. D., The Inheritance of Left-Handedness. *J. Heredity*, 1928, **19**, 557–559.
7. Coons, J. C., and Mathias, R. J., Eye and Hand Preference Tendencies. *J. Genet. Psychol.*, 1928, **35**, 629–632.
8. Critchley, M., *Mirror-Writing.* London: Kegan Paul, Trench, Trubner & Co., 1928. Pp. 80.
9. Cuff, N. B., The Interpretation of Handedness. *J. Exper. Psychol.*, 1928, **11**, 27–39.
10. Cuff, N. B., The Relation of Eyedness and Handedness to Psychopathic Tendencies. *J. Gen. Psychol.*, 1930, **37**, 530–536.
11. Cuff, N. B., A Manoptometer. *Amer. J. Psychol.*, 1930, **42**, 639.
12. Cuff, N. B., A Study of Eyedness and Handedness. *J. Exper. Psychol.*, 1931, **14**, 164–175.
13. Cuff, N. B., A Study of Eyedness and Handedness. *Psychol. Bull.*, 1931, **28**, 327–329.
14. Cummins, H., and Midlo, C., Palmar and Plantar Epidermal Ridge Configurations (Dermatoglyphics) in European-Americans. *Amer. J. Phys. Anthrop.*, 1926, **9**, 471–502.
15. Cummins, H., Lecke, S., and McClure, K., Bimanual Variation in Palmar Dermatoglyphics. *Amer. Jour. Anat.*, 1931, **48**, 199–230.
16. Danielson, R. W., A Study of Unilateral, Voluntary Winking; Some Modifying Factors and Associated Phenomena. Univ. of Colorado Studies, 1930, **18**, No. 2, abstract of unpublished Doctoral Thesis.
17. Dearborn, W. F., The Aetiology of So-Called Congenital Word-Blindness. *Psychol. Bull.*, 1929, **26**, 178–179.
18. Dearborn, W. F., The Nature of Special Abilities and Disabilities. *Sch. & Soc.*, 1930, **31**, 632–636.
19. Dearborn, W. F., Ocular and Manual Dominance in Dyslexia. *Psychol. Bull.*, 1931, **28**, 704.
20. Dennis, W., Sidedness in Sleeping Position in Two Species. *J. Genet. Psychol.*, 1930, **37**.
21. Downey, J. E., Distinguishing Right from Left. *Ped. Sem. & J. Genet. Psychol.*, 1926, **33**, 153–166.

22. DOWNEY, J. E., Further Observations on the Manner of Clasping the Hands. *Amer. Nat.*, 1926, **60**, 387–391.
23. DOWNEY, J. E., Types of Dextrality and Their Implications. *Amer. J. Psychol.*, 1927, **38**, 317–367.
24. DOWNEY, J. E., Dextrality Types Among North American Indians. *J. Exper. Psychol.*, 1927, **10**, 478–488.
25. DOWNEY, J. E., Dextrality Types and the Pre-School Child. *27th Yearbook Nat. Soc. Study of Educ.*, Part II, 153–158.
26. DOWNEY, J. E., Slant in Handwriting and Sinistral Tendencies. *Proceedings: 9th Internat. Cong. Psychol.*, 1929, 151–152.
27. DOWNEY, J. E., Note on an Attempt at Judging Ocular Dominance from Photographs. *J. Exper. Psychol.*, 1930, **13**, 286–289.
28. DOWNEY, J. E., A Note on Bimanual Handedness. *J. of Gen. Psychology*, 1932, **40**, 210–213.
29. DOWNEY, J. E., Back-Slanted Writing and Sinistral Tendencies. *J. Educ. Psychol.*, 1932, **23**, 277–286.
30. DRINKWATER, H., The Left-Handed Child. *Brit. Med. J.*, 1924, **1**, 1113.
31. ELDER, W., The Left-Handed Child. *Brit. Med. J.*, 1924, **1**, 1074; **2**, 80–81.
32. ESTABROOKS, G. H., and HUNTINGTON, E. C., The Relation of Left-Handedness to Psycho-Neurotic Traits and to Introversion. *J. Appl. Psychol.*, 1929, **13**, 192–193.
33. EWERT, P. H., Bilateral Transfer in Mirror-Drawing. *Ped. Sem.*, 1926, **33**, 235–249.
34. FAGAN, L. B., A Case Study of Dextral Training of a Left-Handed Boy and Its Effect on Speech, Reading and Writing. *Psychol. Clinic*, 1931, **19**, 291–293.
35. FLETCHER, J. M., The Problem of Stuttering. New York, 1928. Pp. 64–75.
36. FRIEDMANN, A., Biologie und Psychologie der Linkshändigkeit. *Int. Zsch. f. Indiv.-Psychol.*, 1926, **4**, 257.
37. GATES, A. I., *The Improvement of Reading*. New York, 1927. Pp. xii+440.
38. GELB, A., and GOLDSTEIN, K., Psychologische Analysen Hirnpathologischer Fälle. XII. MAKI, N., Natürliche Bewegungstendenzen der rechten und der linken Hand und ihr Einfluss auf das Zeichnen und der Erkennungsvorgang. *Psychol. Forsch.*, 1928, **10**, 1–19.
39. GELDARD, F. A., and CROCKETT, W. B., The Binocular Acuity Relation as a Function of Age. *J. Genet. Psychol.*, 1930, **37**, 139–145.
40. GESELL, A., *Infancy and Human Growth*. New York: Macmillan, 1928. Pp. xvi+418.
41. GORDON, K., A Study of Hand and Eye Preference. *Child Development*, 1931, **2**, 321–324.
42. GRIFFITH, C. H., A Study of Some "Motor Ability" Tests. *J. Appl. Psychol.*, 1931, **15**, 109–125.
43. HAEFNER, R., The Educational Significance of Left-Handedness. *Teach. Coll. Cont. to Educ.*, 1929. Pp. 92.
44. HAEFNER, R., The Relation Between Hand and Foot Tendencies of Children. *J. Genet. Psychol.*, 1930, **38**, 338–351.

45. Heinlein, J. H., A Study of Dextrality in Children. *Ped. Sem. & J. Genet. Psychol.*, 1929, **36**, 91–119.
46. Heinlein, J. H., Preferential Manipulation in Children. *Comp. Psychol. Monog.*, 1930, *7*, 1–121.
47. Ide, H., On Several Characters Shown by the Cross-Sections of the Median and Sciatic Nerves of Human Males According to Race. *J. Comp. Neur.*, 1930, **51**, 457–458.
48. Ingalls, W., On Right-Handedness. *Scient. Month.*, 1928, **27**, 307–321.
49. Johnson, B., *Mental Growth of Children.* New York: E. P. Dutton, 1925. Pp. xix+160.
50 Johnson, B., Changes in Muscular Tension in Coördinated Hand Movements. *J. Exper. Psychol.*, 1928, **11**, 329–341.
51. Johnson, W., *Because I Stutter.* Introduction by L. E. Travis. New York: D. Appleton & Co., 1930. Pp. xv+127.
52. Jones, H. E., Dextrality as a Function of Age. *J. Exper. Psychol.*, 1931, **14**, 125–143.
53. Jones, M. C., The Development of Early Behavior Patterns in Young Children. *J. Genet. Psychol.*, 1926, **33**, 537–585.
54. Kingman, R., Mirror Writing: The Modern Survival of Primitive Functions. *Welfare Mag.*, 1928, **19**, 495–505.
55. Kingman, R., The Southpaw: The Left-Handed Individual Comes into His Own. *Welfare Mag.*, 1928, **19**, 606–613.
56. Kistler, K., Linkshändigkeit und Sprachstörungen. *Schweiz. med. Woch.*, 1930, **60**, 32–34.
57. Krahmer, W., and Korst, L., Zum Problem der Links- und Rechtshändigkeit. *J. f. Psychol. u. Neur.*, 1925, **31**, 311–322.
58. Lecke, S. M., Handedness and Bimanual Dermatoglyphic Differences. Paper, Amer. Assoc. Anatomists, 1932.
59. Lineback, P., Some Observations on the Mechanism of Double Vision. *Anat. Rec.*, 1928, **38**, 193–201.
60. Lord, E. E., Carmichael, L., and Dearborn, W. F., Special Disabilities in Learning to Read and Write. *Harvard Monog. in Educ.*, 1925, II, 1–76.
61. Lund, F. H., Physical Asymmetries and Disorientation. *Amer. J. Psychol.*, 1930, **42**, 51–62.
62. Lund, F. H., The Monoptometer: A New Device for Measuring Eye-Dominance. *Amer. J. Psychol.*, 1932, **44**, 181–183.
63. McGinnis, E., The Acquisition and Interference of Motor Habits in Young Children. *Genet. Psychol. Monog.*, 1929, **6**, No. 3, 209–371.
64. Miles, W. R., Ocular Dominance Demonstrated by Unconscious Sighting. *J. Exper. Psychol.*, 1929, **12**, 113–126.
65. Miles, W. R., Ocular Dominance in Human Adults. *J. Gen. Psychol.*, 1930, **3**, 412–430.
66. Mills, L., Eyedness and Handedness. *Am. J. Ophthal.*, 1925, **8**, 1–8.
67. Morsh, J. E., The Development of Right-Handed Skill in the Left-Handed Child. *Child Development*, 1930, **1**, 311–324.
68. Munn, N. L., Bilateral Transfer of Learning. *J. Exp. Psychol.*, 1932, **15**, 343–353.

69. NEPOKOJ, J., L'ecriture et la lecture bilaterales. *J. de Psychol.*, 1927, **24**, 747–751.

70. NEWMAN, H. H., Studies of Human Twins. II. Asymmetry Reversal, or Mirror Imaging in Identical Twins. *Biol. Bull.*, 1928, **55**, 298–315.

71. NEWMAN, H. H., Mental and Physical Traits of Identical Twins Reared Apart. *J. of Heredity*, 1929, **20**, 49–64, 97–104, 153–166.

72. NEWMAN, H. H., Palmar Dermatoglyphs of 100 Pairs of Twins. *Am. J. Phys. Anthrop.*, 1930, **14**.

73. OATES, D. W., Left-Handedness in Relation to Speech Defects, Intelligence and Achievement. *Forum of Educ.*, 1929, **7**, 91–103.

74. OJEMANN, R. H., A Study of the Relation of Handedness to Speech, with Emphasis on the Technique of Testing Handedness. Univ. of Chicago, Abstracts of Theses. Humanistic Series, **7**, 1928–29, 145–149.

75. OJEMANN, R. H., Studies in Handedness: I. A Technique for Testing Unimanual Handedness. *J. Educ. Psychol.*, 1930, **21**, 597–611.

76. OJEMANN, R. H., Studies of Handedness: II. Testing Bimanual Handedness. *J. Educ. Psychol.*, 1930, **21**, 695–702.

77. OJEMANN, R. H., Studies in Handedness: III. Relation of Handedness to Speech. *J. Educ. Psychol.*, 1931, **22**, 120–126.

78. ORTMANN, H., "Linkskultur" mit Schwachsinnigen. *Zsch. f. Schulgesundheitspflege u. soz. hygiene*, 1930, **43**, 377–382 (Soc. Sci. Abst. III:3411).

79. ORTON, S. T., Word Blindness in School Children. *Arch. of Neurol. & Psychiat.*, 1925, **14**, 581–615.

80. ORTON, S. T., An Impediment to Learning to Read. *Sch. & Soc.*, 1928, **28**, 286–289.

81. ORTON, S. T., Familial Occurrence of Disorders in Acquisition of Language. *Eugenics*, 1930, **3**, 140–146.

82. ORTON, S. T., and TRAVIS, L. E., Studies in Stuttering: Studies of Action Currents in Stutterers. *Arch. Neur. & Psychiat.*, 1929, **21**, 61–68.

83. PARSON, B. S., *Left-Handedness*. New York: Macmillan, 1924. Pp. vii+185.

84. PAYNE, C. S., The Mispronunciation of Words. *J. Genet. Psychol.*, 1930, **38**, 427–444.

85. PETERSON, G. M., A Preliminary Report on Right and Left Handedness in the Rat. *J. Comp. Psychol.*, 1931, **12**, 243–250.

86. QUINAN, C., The Principal Sinistral Types. An Experimental Study Particularly as Regards Their Relation to the So-Called Constitutional Psychopathic States. *Arch. Neur. & Psychiat.*, 1930, **24**, 35–47.

87. QUINAN, C., The Handedness and Eyedness of Speeders and of Reckless Drivers. *Arch. Neur. & Psychiat.*, 1931, **25**, 829–837.

88. REICHLE, H. A., The Diagnosis of Monovular Twinning. *Biol. Bull.*, 1929, **56**, 313–326.

89. RICHARDS, T. W., A Clinical Study of a Severe Case of Reading Disability in a Left-Handed Child Who Was Taught to Read by a Combined Graphomotor and Vocomotor Method. *Psychol. Clinic*, 1931, **19**, 285–290.

90. SCHAEFFER, A. A., Spiral Movements in Man. *J. Morph. & Physiol.*, 1928, **45**, No. 1, 293–398.

91. SCHEIDEMANN, N. V., A Study of the Handedness of Some Left-Handed Writers. *J. Genet. Psychol.*, 1930, **38**, 510–516.
92. SCHEIDEMANN, N. V., A Simple Test for Ocular Dominance. *Am. J. Psychol.*, 1931, **43**, 126.
93. SCHEIDEMANN, N. V., *The Psychology of Exceptional Children.* Boston: Houghton Mifflin, 1931. Pp. xi+520.
94. SCHEIDEMANN, N. V., and COLYER, H., A Study in Reversing the Handedness of Some Left-Handed Writers. *J. Educ. Psychol.*, 1931, **22**, 191–196.
95. SCHEIDEMANN, N. V., and COLYER, H., A Study of Causes of Left-Handed Writing Preferences of Some Right-Handed Children. *Psychol. Clinic*, 1931, **20**, 116–119.
96. SMITH, G. E., Right- and Left-Handedness in Primitive Men. *Brit. Med. J.*, 1925, **2**, 1107–1108.
97. SMITH, J. M., Which Hand Is the Eye of the Blind? *Genet. Psychol. Monog.*, 1929, **5**, No. 3, 213–252.
98. SNYDER, A. M., and M. A., Eye Preference Tendencies. *J. Educ. Psychol.*, 1928, **19**, 431–433.
99. TRAVIS, L. E., A Comparative Study of the Performances of Stutterers and Normal Speakers in Mirror-Tracing. *Psychol. Monog.*, 1928, **39**, 45–51.
100. TRAVIS, L. E., Recurrence of Stuttering Following Shift from Normal to Mirror-Writing. *Arch. Neur. & Psychiat.*, 1929, **21**, 386–391.
101. TRAVIS, L. E., and HERREN, R. Y., Studies in Stuttering. V. A Study of Simultaneous Antitropic Movements of the Hands of Stutterers. *Arch. Neur. & Psychiat.*, 1929, **22**, 487–494.
102. TSAI, L. S., and MAURER, S., "Right-Handedness" in White Rats. *Science*, 1930, **72**, 436–438.
103. UHRBROCK, R. S., What Shall We Do with the Left-Handed Child? *Cornell Rural School Leaflet*, 1930, **24**, No. 1, 122–129.
104. UHRBROCK, R. S., A Theory Concerning the Origin of Differences in Handedness. *Announcement and Proceedings*, A.A.A.S. Meeting, 1930.
105. VALSIK, J. A., The Problem of Right- and Left-Handedness in the Light of Epidermal Configurations of the Palm of the Hand. *Casopis Lekaru Ceskych*, 1928, **67**. (In Czech, with summary in English.)
106. WALLIN, J. E. W., Speech Defective Children in a Large School System. *Miami Univ. Bull.*, Series 25, No. 4, 1926, 1–45.
107. WATSON, GOODWIN, First International Neurological Congress. *Amer. J. Psychol.*, 1932, **44**, 384–389.
108. WELLMAN, B. L., The Development of Motor Coördinations in Young Children. *Univ. of Iowa Studies in Child Welfare*, 1926, **3**. Pp. 93.
109. WETMORE, R. G., and ESTABROOKS, G. H., The Relation of Handedness to Psycho-Neurotic Traits. *J. Educ. Psychol.*, 1929, **20**, 628–629.
110. WHITE, A. M., and DALLENBACH, K. M., Position vs. Intensity as a Determinant of the Attention of Left-Handed Observers. *Amer. J. Psychol.*, 1932, **44**, 175–179.
111. WILE, I. S., The Relation of Left-Handedness to Behavior Disorders. *Amer. J. Orthopsychiat.*, 1932, **2**, 44–57.

112. WILSON, M. O., and DOLAN, L. B., Handedness and Ability. *Amer. J. Psychol.*, 1931, **43**, 261–268.
113. WOO, T. L., and PEARSON, K., Dextrality and Sinistrality of Hand and Eye. *Biometrica*, 1927, **19**, 165–199.
114. WOO, T. L., Dextrality and Sinistrality of Hand and Eye. *Biometrica*, 1928, **20**, 79–148.
115. YOSHIOKA, J. G., A Note on the Right and Left Going Position Habit with Rats. *J. Comp. Psychol.*, 1928, **8**, 429–433.
116. YOSHIOKA, J. G., Handedness in Rats. *Psychol. Bull.*, 1930, **27**, 656–657.
117. YOSHIOKA, J. G., Handedness in Rats. *J. Genet. Psychol.*, 1930, **38**, 471–474.
118. YOSHIOKA, J. G., A Further Note on a Position Habit in Rats. *J. Comp. Psychol.*, 1930, **10**, 309–315.

SUPPLEMENTARY BIBLIOGRAPHY ON "LATERALITY OF FUNCTION"

THELMA DREIS
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119. ANON., Do Not Change Dominant Hand of Child in Writing. *Hygeia*, 1932, **10**, 959.
120. ANON., Handedness and Eyedness. *Lit. Digest*, 1925, **87**, 23.
121. ANON., Inheritance of Left-Handedness. *Lit. Digest*, 1929, **101**, 21.
122. ANON., Left-Handed Children. *Elem. Sch. J.*, 1927, **28**, 253–255.
123. ANON., Left-Handedness and Mirror-Writing. *Lit. Digest*, 1927, **94**, 54–56.
124. ANON., Left-Handed Violinists. *Étude*, 1925, **43**, 372.
125. ANON., Right- and Left-Handed Fossils. *Lit. Digest*, 1926, **88**, 74–75.
126. ANON., Ruth, Who Couldn't Read. *Survey*, 1927, **59**, 225.
127. ARMAINGAUD, —, Appeal of Académie de Médecine to People and Government for Equal Education and Use of Right and Left Hands. *Bull. Acad. de Méd.*, Paris, 1930, **104**, 48–53.
128. ARNSTEIN, E., Das Problem der Linkshändigkeit. *Ped. rozhledy*, 1931, **10**, 449–455, 520–525 (*Psychol. Abstr.*, 1932, No. 474).
129. ASTWAZATUROW, M., Zur Lehre von der Entstehung der Rechtshändigkeit. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1925, **98**, 133–137.
130. BERTELSEN, A., Left-Handedness in Greenland. *Holpitalstid*, 1928, **71**, 1393–1415.
131. BETHE, A., Zur Statistik der Links- und Rechtshändigkeit und der Vorherrschaft einer Hemisphaere. *Deutsche Med. Wchnschr.*, Leipzig and Berlin, 1925, **11**, 681–683.
132. BINGHAM, W. V., *Psychology Today; Lectures and Study Manual.* Chicago: Univ. of Chicago Press. 1932. Pp. 271.
133. BRANN, R., Right- and Left-Handedness in Children and Their Ability to Recognize Figures from Movement of Hands. *Arch. f. Psychiat.*, 1929, **86**, 255–271.
134. BROUN, H., It Seems to Heywood Broun. *Nation*, 1929, **128**, 757.

135. Bürger, H., Physiologic Aspects of Left-Handedness. *Nervenarzt*, 1929, **2**, 464–472.

136. Carmichael, L., The History of Mirror-Drawing as a Laboratory Method. *Ped. Sem. & J. Genetic Psychol.*, 1927, **34**, 90–91.

137. Clinton, R. J., Nature of Mirror-Drawing Ability: Norms on Mirror-Drawing for White Children by Age and Sex. *J. Educ. Psychol.*, 1930, **21**, 221–228.

138. Cohn, H. A., and Papez, J. W., A Comparative Study of the Visuosensory or Striate Area in the Two Hemispheres of the Human Brain. *Amer. J. Phys. Anthrop.*, 1930, **14**, 405–415.

139. Condon, R. J., Advice with Regard to the Treatment of Left-Handed Writers. *Elem. Sch. J.*, 1927, **27**, 490.

140. Creswell, R., Student Pedigree-Studies; Inheritance of Left-Handedness and Mechanical Capacity. *Eugenic News*, 1932, **17**, 13–14.

141. Cunningham, B., On the Other Hand. *il Collier's*, 1932, **90**, 18.

142. Downey, J. E., Handedness. *Ency. Brit.* (14th Ed.), 1929, **11**, 142–143.

143. Downey, J. E., Some Curious Problems Suggested by Case-Studies of Handedness. *J. of Abn. & Soc. Psychol.*, 1932, **27**, 152–158.

144. Earle, F. M., *The Measurement of Manual Dexterities.* National Institute of Industrial Psychol. (Eng.), 1930, Report 4. Pp. 88.

145. Ehinger, G., Development of Right- and Left-Handedness Through Practising Manual Trade. *Arch. de Psychol.*, 1927, **20**, 299–317.

146. Fagan, L. B., A Clinico-Experimental Approach to the Reëducation of the Speech of Stutterers. *Psych. Monog., Univ. of Iowa Studies in Psychol.*, 1932, **43**, 53–66.

147. Fernald, G. M., A Criticism of Unilateral Cerebral Dominance as an Explanation of Word Blindness. Reported before Western Psychol. Ass'n, June 13 and 14, 1930.

148. Friedmann, A., Schematische Darstellung des Antiels, der Linkshändigkeit on der Entfaltung von Charakterzügen und Fähigkeiten. *Int. Zsch. f. Indiv.-Psychol.*, 1931, **9**, 60 (*Psychol. Abstr.*, 1932, No. 4292).

149. Gernelli, A., Recherches sur la Nature de l'Habileté Manuelle. *J. de Psychol.*, 1929, **26**, 163–200.

150. Gordon, K., Some Notes on the Mental Status of the Left-Handed. *J. of Delinquency*, 1923, **8**, 154–157.

151. Goroncy, C., Unusual Observations of Left-Handed Writing. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1932, **138**, 316–319.

152. Hanse, A., Mirror-Writing, Left-Handedness and Alexia. *Arch. f. Psychiat.*, 1931, **93**, 34–45.

153. Hardwick, R. S., Left-Handed Child. *il Nat. Educ. Ass'n J.*, 1928, **17**, 263–264.

154. Harford, C. F., The Child. London, Jan., 1924. (A paper read at a conference of school medical officers of the Herts County Council.)

155. Harford, C. F., Letter on Left-Handed Problem, dated June 14, 1924, to Editor of *Brit. Med. J. Brit. Med. J.*, 1924, **1**, 1113.

156. Harrenstein, R. J., Moet bij de Beroepskeuze Rekening gehouden Worden met Linkshandigheid? *Jeugd en Beroep*, 1930, **3**, 339–345 (*Psychol. Abstr.*, 1931, No. 4379).

157. HEINLEIN, C. P., A Simple Marble Timing Device for Investigation of Preferential Manipulation. *J. Gen. Psychol.*, 1930, **3**, 178–179.

158. HOFF, H., and PÖTZL, O., Aphasia in Polyglottism; Case in Left-Handed Patient. *Wien med. Wschnschr.*, 1932, **82**, 369–373.

159. HUBER, B., Why Are We Right-Handed? *Scient. Am.*, 1910, **102**, 260–261.

160. JULLIARD, C., Left-Handedness. *Bruxelles-Méd.*, 1931, **11**, 690–697.

161. KAMM, B., Statistical Studies on Left-Handedness and Its Variations. *Klin. Wchnschr.*, 1930, **9**, 435–440.

162. KELLY, G. A., Some Common Factors in Reading and Speech Disabilities. *Psychol. Monog., Univ. of Iowa Studies in Psychol.*, 1932, **43**, 175–201.

163. KURODA, G., Observations on Right- and Left-Eyed Children. *Nippon Gakko Eidei* (*Japanese Sch. Hygiene*), 1927, **11**, No. 6 (*Psychol. Abstr.*, 1927, No. 287).

164. LAMB, E. O., Racial Differences in Bimanual Dexterity of Latin and American Children. *Child Development*, 1930, **1**, 204–231.

165. LICKINT, F., Rechtshändigkeit und Linkshändigkeit. *Umschau*, Frankfurt a. M., 1925, **29**, 709–712.

166. LOCKE, R. W., Left-Handedness. *M. Officer*, 1929, **42**, 17.

167. LODGE, J. E., What It Means to Be Left-Handed. *il Pop. Sci.*, 1931, **118**, 57–58.

168. LOEFFLER, F., Left-Handedness in Surgery. *Chirug.*, 1931, **3**, 897–899.

169. LUDWIG, W., *Das Rechts-Links-Problem im Tierreich und beim Menschen mit einem Anhang Rechts-Links-Merkmale den Pflanzen.* Berlin, J. Springer, 1932. Pp. xi+496 (Bibliography of 695 titles).

170. LUND, F. H., The Dependence of Eye-Hand Coördinations upon Eye-Dominance. *Amer. J. Psychol.*, 1930, **44**, 756–762.

171. MERRY, R. V., Which Hand Is the Eye of the Blind? *Teach. Forum* (*Blind*), 1930, **2**, 4–6.

172. MILES, W. R., *The a-b-c-Vision Test.* 1928. (Privately printed.)

173. MILLS, L., Unilateral Sighting. *Calif. & West Med.*, 1928, **28**, 189–195.

174. MINOR, L., Left- and Right-Handedness and Dorsal Venous Network of Hand. *Rev. Neurol.*, 1931, **2**, 488.

175. MINOR, L., Dorsal Venous Network of Hands in Relation to Handedness. *Deutsche Ztschr. f. Nervenh.*, 1932, **126**, 1–18.

176. MONROE, M., Methods for Diagnosis and Treatment of Cases of Reading Disability. *Genetic Psychol. Monog.*, 1928, **4**, 333–456.

177. MONROE, M., *Children Who Cannot Read: The Analysis of Reading Disabilities and the Use of Diagnostic Tests in the Instruction of Retarded Readers.* Chicago: Univ. of Chicago Press, 1932. Pp. xvi+206.

178. MUNRO, L., Unusual Combination of Left-Handedness and Stammer. *Lancet*, 1932, **1**, 84–85.

179. NEALL, H. E., Living with Your Left-Handed Child. *Calif. Parent-Teacher*, 1931, **14**, 37.

180. OAK, L. S., *Motor Difficulties of Left-Handed Children in Learning to Write and to Draw.* Doctoral Dissertation in the Library of Yale University, 1930.

181. ORTON, S. T., Training the Left-Handed. *Hygeia*, 1927, **5**, 451–454.

182. Orton, S. T., Specific Reading Disability—Strephosymbolia. *J. of the Am. Med. Ass'n*, 1928, **90**, 1095–1099.
183. Orton, S. T., A Physiological Theory of Reading Disability and Stuttering in Children. *New Eng. J. of Med.*, 1928, **199**, 1046–1052.
184. Orton, S. T., The "Sight Reading" Method of Teaching Reading as a Source of Reading Disability. *J. of Educ. Psychol.*, 1929, **20**, 135–143.
185. Pascal, J. I., The Chromatic Test for the Dominant Eye. *Amer. J. Ophth.*, 3rd Series, 1926, **9**, 357–358.
186. Potter, A., Left-Handedness, Stuttering and Congenital Word-Blindness. *Geneesk. tijdschr. V. nederl. Indië*, 1931, **71**, 1349–1354.
187. Pyle, W. H., and Drouin, A., Left-Handedness: An Experimental and Statistical Study. *School & Soc.*, 1932, **36**, 253–256.
188. Raspolsky, I., Bis Entstehung der Funktionellen Einhändigkeit (Rechts-Links-Händigkeit). *Deutsche Ztschr. f. Nervenh.*, Leipzig, 1925, **84**, 314–324.
189. Rauschburg, P., Die Lese- und Schrusstörungen des Kindesalters. Ihre Psychologie, Physiologie, Heilpädagogische und Medizinische Therapie. *Halle, a.S.: C. Marhold*, 1925, **64** (*Psychol. Abstr.*, 1929, **3**, No. 482).
190. Regnault, F., Causes of Right-Handedness in Man. *Presse Méd.*, 1931, **39**, 787–789.
191. Regnault, F., Right-Handedness from Sociologic Point of View. *Presse Méd.*, 1931, **39**, 1035–1036.
192. Regnault, F., Biologic Explanation of Right-Handedness; Teaching of Ambidexterity to Children. *Presse Méd.*, 1931, **39**, 1367–1368.
193. Rice, G., Is There Hope for the Southpaw? *Collier's*, 1924, **74**, 14.
194. Rice, G., Watch the Southpaw. *il Colliers*, 1927, **79**, 8.
195. Root, A. R., A Survey of Speech Defectives in the Public Elementary Schools of South Dakota. *Elem. Sch. J.*, 1926, **7**, 531–541.
196. Rothschild, E., Über Links und Rechts. Eine Erscheinungswissenschaftliche Untersuchung. *Ztschr. f. d. ges. Neur. u. Psychiat.*, 1930, **124**, 451–512.
197. Rothschild, K., Relation of Broca's Center to Lefthandedness. *Am. J. M. Sc.*, 1931, **182**, 116–118; also *M. Press.*, 1931, **132**, 113–114.
198. Scalzitti, M., Mancinismo e destrismo in oto-rino-laringologia. Rinopletismografia. *Atti d. Clin. Otorinolar. d. R.*, Univ. di Roma, 1931, 229–235 (*Psychol. Abstr.*, 1932, No. 2711).
199. Scheidemann, N. V., and Robinette, G. E., Testing the Ocular Dominance of Infants. *Psychol. Clinic*, 1932, **21**, 62–63.
200. Schiller, M., Left-Handedness Among School Children in Stuttgart, Germany. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1932, **140**, 496–516.
201. Schott, A., Left-Handedness in Feeblemindedness. *Ztschr. f. d. Behandl. Anomal.*, 1930, **50**, 97–101.
202. Schott, A., Über Rechts und Links beim Menschen. *Monatssch f. Psychiat. u. Neur.*, 1930, **77**, 186–202. (Reviews 73 articles.)
203. Schott, A., Heredity of Left-Handedness. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1931, **135**, 305–313.
204. Stern, G., and Schilf, E., Left-Footedness, Relation to Left-Handedness. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1932, **139**, 41–43.
205. Swift, S. C., (No title). *Outlook for the Blind*, 1930, **23**, 51–55.

206. TILBY, A. W., Origin of Right. *19th Cent.*, 1930, **107**, 122–140.
207. TRAVIS, L. E., *Speech Pathology.* New York: D. Appleton & Co., 1931. Pp. 331.
208. TRAVIS, L. E., and LINDSLEY, D. B., An Action Current Study of Handedness. Reported before the Am. Psychol. Ass'n, Sept. 8, 9, and 10, 1932.
209. UPDEGRAFF, R., Ocular Dominance in Young Children. Reported before the Am. Psychol. Ass'n, Sept. 8, 9, and 10, 1932.
210. UPDEGRAFF, R., Ocular Dominance in Young Children. *J. of Exp. Psychol.*, 1932, **15**, 758–766.
211. URECHIA, C. I., Left-Handed Epileptic; Case. *Bull. et mém. Soc. méd. d. hôp. de Paris*, 1932, **48**, 149–151.
212. VERNON, M. D., *An Experimental Study of Reading.* Cambridge: Cambridge University Press, 1931. Pp. 190.
213. VORWAHL, —, Zum Problem der Linkshändigkeit. *J. f. Psychol. u. Neurol.*, Leipzig, 1925, **32**, 93–95.
214. WEVILL, L. B., Occipital Bone and Bones of Superior Extremity in Relation to "Right" or Left Handedness. *Edinburgh M. J.*, 1928, **35**, 12–20.
215. WILE, I. S., Left-Handedness. *Parents M.*, 1930, **5**, 29.
216. WILE, I. S., When Left Is Right. *il Delin.*, 1932, **120**, 18.
217. WILLEY, G. F., Personality Deviations Associated with Sinistrality and with Defective Hearing. *Pennsylvania M. J.*, 1931, **34**, 296–300.
218. WILSON, P. T., and JONES, H. E., Left-Handedness in Twins. *Genetics*, 1932, **17**, 560–571.
219. ZUTT, J., Pathologic Study of Left and Right Disturbance, Constructive Apraxia and Pure Agraphia; Case. *Monatschr. f. Psychiat. u. Neurol.*, 1932, **82**, 253–305, 355–395.

THE CONSTANCY OF THE I.Q.

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That the constancy of the intelligence quotient has attracted much attention is shown by the great amount of research that has been done in order to verify the theory of constancy. Much of the literature concerning the problem has been concisely summarized by Foran (**36, 37**), Burks (**16**), and Baldwin (**60**). They have considered many of the studies in which the Stanford Revision of the Binet-Simon Tests was used; therefore, there seems to be a need for a review of investigations dealing with the constancy of the I.Q. derived from revisions of the Binet-Simon Tests other than the Stanford-Binet and group tests. Furthermore, various researches on the influence of training, environment, and physical condition on the I.Q. have been made.

A. Revisions of the Binet-Simon Other than the Stanford-Binet

Using the 1908 and 1911 Binet Tests, the Yerkes-Bridges Point Scale, the Goddard, Kuhlmann, and Herring Revisions, or some altered form of the Stanford-Binet Tests, Bloch and Lippa (**69**), Bobertag (**70**), Chotzen and Nicolauer (**85**), Berry (**66**), Goddard (**131**), Descoeudres (**245**), Downey (**105**), Rosenow (**201**), Garrison (**124, 125**), Kuhlmann (**157**), Doll (**32**), Terman (**220**), Dvorak (**107**), Wallin (**230**), Anderson (**57**), Henmon and Burns (**144**), Gray and Marsden (**134, 135, 136, 137**), Goodenough (**20, 40**), Carroll and Hollingworth (**78**), and Cuff (**92**) have contributed some data concerning the constancy of the intelligence quotient of children of all levels of mental ability.

As reported in the literature, most of these studies are inadequate because the data are very fragmentary. In most cases the writers have not specified age, grade, or I.Q. ranges; in many experiments the central tendencies and variabilities of I.Q.'s and other measures are not indicated. Furthermore, some investigators have not reported the coefficients of correlation between test and retest, the intervals between tests, the changes in I.Q.'s, or the P.E. of measure-

ment. Because they have failed to present significant facts, it is impossible to compare their results.

Bobertag (70) used the 1908 Binet Tests to study the constancy of the I.Q. in 83 normal children, finding an r of .95±.024 between test and retest, the interval between tests being one year. Using the 1911 Binet Tests and the Stanford-Binet at an average interval of 10.26 months, Rosenow (201) obtained an r of .82±.027 between test and retest of 69 cases. With the Herring-Binet, Cuff (92) found r's of .98±.01 between test and retest I.Q.'s of two groups of 23 and 24 cases. The interval between tests was 24 hours. The value of this study is questionable because of the small number of cases.

Results from the Kuhlmann 1922 Revision of the Binet Scale as reported by Goodenough (20, 40) are important. She tested and retested 300 children at an interval of six weeks. The range of changes in I.Q.'s was from +39 to —21. Of the total group, 8.9 per cent gained 20 points or more; 4.9 per cent lost 10 points or more. The r for test and retest was .813±.012.

The following table gives the gist of Goodenough's findings.

TABLE I

SUMMARY OF DATA PRESENTED BY GOODENOUGH

Age	Boys	Girls	Mean I.Q. 1st Test	S.D. 1st	Mean I.Q. 2nd Test	S.D. 2nd	Mean Algebraic Changes
2	50	50	105.1	13.0	108.1	15.5	3.0
3	50	50	104.4	18.2	107.6	21.7	3.2
4	50	50	109.4	16.6	116.0	15.3	6.6
All	150	150	106.3	16.2	110.6	18.1	4.3

After making a few adaptations in the Stanford-Binet in order to test English children, Gray and Marsden (134, 135, 136, 137) made some important studies concerning I.Q. constancy. Their subjects ranged from three to thirteen years of age at the first testing. A summary of Gray and Marsden's data is given in Table II.

TABLE II

RÉSUMÉ OF STUDIES CONCERNING THE CONSTANCY OF THE I.Q. BY GRAY AND MARSDEN

Testings	N	r	Range of Middle 50 Per Cent of Differences	Semi-inter-quartile Range of Changes	Median I.Q. Change	Interval in Years
1 & 2	100	.887 ± .014	—2.25 to 7.66	4.95	2.25	1
2 & 3	55	.908 ± .016	—3.03 to 3.0	3.01	0.0	1
1 & 3	63	.836 ± .059	—1.0 to 7.25	4.12	3.5	2
All	218	.883 ± .036	—2.7 to 7.0	4.85	1.6	1—2
1 & 2	100	.883 ± .015	—2.25 to 7.7	5.0	2.25	1
4	371	.854 ± .011				1—3
6	616	.851 ± .008	—6.1 to 4.7	5.5	—1.3	1—5

At an interval of one year, Carroll and Hollingworth (**78**) retested 52 gifted children, ages seven to nine at the first testing, with the Herring-Binet. From the original data presented by the authors, it was found that the range of I.Q. changes was from —19 to +22; the average change regardless of signs was 9.06; algebraically the range of the middle 50 per cent of changes was —4.0 to 11.67. The r between test and retest was .73±.044. Other important data from this study are:

Test	Range of I.Q.'s	Mean I.Q.	S.D. of I.Q.'s
1	108–174	135.8	13.8
2	116–173	138.8	13.3

From the standpoint of the constancy of the I.Q., with the exception of the data presented by Gray and Marsden, Goodenough, and Carroll and Hollingworth, the studies using revisions of the Binet-Simon other than the Stanford are inadequate and incomplete. Studies of lesser importance have been made by Bobertag, Rosenow, and Cuff.

B. The Stanford-Binet

The constancy of the I.Q. as derived from the Stanford-Binet has been studied extensively by Cuneo and Terman (**93**), Terman (**10**), Stenquist (**210, 211**), Rugg and Colloton (**203**), Baldwin and Stecher (**27, 61, 62**), Poull (**187**), Garrison (**122**), Gordon (**133**), Berry (**67**), Dickson (**4**), Johnson (**151**), Irwin and Marks (**6**), Madsen (**171**), Garrison and Robinson (**126**), Johnson (**7**), Rugg (**204**), Hildreth (**145**), Wentworth (**54**), Lincoln (**164**), Randall (**190**), Freeman, Holzinger, and Mitchell (**19**), Matthew and Luckey (**24**), Rogers, Durling, and McBride (**25, 197**), Carroll and Hollingworth (**78**), Cattell (**79**), Lamson (**46**), Brown (**77**), and Burks, Jensen, and Terman (**1**).

Some of these studies were inadequate in that certain data are not presented. Furthermore, the studies include wide age and grade and I.Q. ranges; consequently, one is not justified in comparing these experiments with each other. In Table III the salient features of the important studies are summarized.

Many other sources of data concerning the constancy of the I.Q. are available; however, because of inadequate and incomplete treatment, small number of cases, the method of analysis, or the style of presentation, the researches are of secondary importance. Studies in this category have been made by Fermon (**35**), Woolley and Ferris (**56**), Bronner (**71**), Dougherty (**104**), Ford (**112**), Root (**200**), Slocombe (**207, 209**), Stern (**212, 213**), Teagarden (**218**), Chipman (**84**), Prouty (**188**), and Minogue (**175**).

TABLE III

THE CONSTANCY OF THE STANFORD-BINET I.Q.

Experimenter and Date	N	Testing Intervals	r	P.E.	Mean I.Q. Change	Range of Middle 50 Per Cent of Change	Grade or Age Range
Cuneo and Terman (1918)	31	20–24 mos.	.852	.034	6 (Md.)	5–13	3–11 to 6–4
	21	5–7 mos.	.942	.014	6 (Md.)	3–7	3–8 to 6–6
	25	2 days	.95	.013	3 (Md.)	2–7	3–8 to 8–1
Terman (1919)	428	1 day to 7 years	.93	.004	4.5	—3.3 to 5.7	3 to above 15 years
Stenquist (1920)	274	Less than 1–3 years	.72	.02	Md. gain 9.5; Md. loss 5.9		3–0 to 11–11
Rugg and Colloton (1921)	137	10 mos. to 1 yr. 4 mos.	.84	.012	4.7	—2.3 to 5.6	6.0 to 12
Baldwin and Stecher* (1922)	36		.85	.03	4.11 6.33	—2.33 to 9.00 3.25 to 9.00	
	36		.74	.05	4.36 9.42	—4.00 to 11.00 5.50 to 12.00	
	36		.78	.04	8.53 10.19	2.33 to 15.67 4.00 to 15.67	
	36		.82	.04	11.31 12.25	6.00 to 17.00 7.50 to 17.00	
	36		.85	.03	.25 6.69	—7.00 to 6.00 4.00 to 9.75	
	36		.80	.04	4.42 7.75	—2.00 to 12.00 3.00 to 12.00	
	36		.82	.04	7.19 8.25	2.50 to 13.00 4.00 to 13.00	

	36		.91	.02	4.17 5.61	.33 to 9.00 2.13 to 9.00	
	36		.84	.03	6.94 8.06	2.00 to 11.50 3.50 to 11.50	
	36		.92	.02	2.78 4.78	—2.00 to 6.33 2.40 to 6.50	
Poull (1921)	124	6 mos. to 3 years			4.6	—3.3 to 4.8	4–28 years
Garrison (1922)	468	1–4 years	.88	.007	5.4	—2 to 4	
	43	4 years	.83	.032		—3 to 4	
	127	2 years	.91	.01		—3 to 5	
	298	1 year	.88	.009			
Gordon (1922)	44	1 yr. 3 mos. to 2–10	.84	.03	6.8		4 yrs. 2 mos. to 13–7
Berry (1923)	351	11 mos. (6–18)	.74	.02	5.0		6 to 14 years
	273	23 mos. (19–30)	.67	.02	6.1		
	82	35 mos. (31–48)	.56	.08	7.4		
Dickson (1923)	288	13 mos. (1 mo.—3 years)	.90	.01	5.1 (Md.)	—5.6 to 4.4	4–16 years
Henmon and Burns (1923)	59	9 mos. to 4 years	.91	.01	5.3	—6 to 3	Not given
Johnson (1923)	94	1–4 years	.69	.03			Grades I–VII
Irwin and Marks (1924)	322 (289)	1 mo. to 5 years	.98	.004			5–15 years
Madsen (1924)	16	1½ years	.97	.01	2.125	—1 to 2.67	Grade 1
	34	3 yrs. 5 mos.	.85	.032			Grades 1 to 8
Garrison and Robinson* (1925)	140	10 mos.	.88	.013		—2 to 4	Grades 3 to 8
	131	20 mos.	.91	.01		—3 to 4	Ages 8–5 to 15–3
	131	10 mos.	.92	.009		—2 to 3	

TABLE III (Continued)

Experimenter and Date	N	Testing Intervals	r	P.E.	Mean I.Q. Change	Range of Middle 50 Per Cent of Change	Grade or Age Range
Johnson (1925)	125		.80	.022			2–10 years
Rugg (1925)	114	Md. 21 mos. 4–36 mos.	.948	.006	3.1	—1.2 to 1.9	5–0 to 15–11
Hildreth (1926)	441	Less than a mo. to					
	1112	8 years	.857	.009	4.605 (Q.)	—3.5 to 5.71	3–18 years
		Average of 1–2 yrs.	.814	.007	.96 (Md.)		Mean of 9 years
Wentworth (1926)	145	3 days to 16 mos.	.82	.02	(Md. 5)		Grade 1
Lincoln (1927)	30	3½ to 4 hours	.95	.013	2.57		6 and 7 years
Randall (1927)	103	0–18 mos.	.798	.025			Grades 1–9
	37	19–30 mos.	.699	.057			Ages 5–2 to 15–10
	6	31–42 mos.	.793	.103			
	6	43–66 mos.	.801	.100			
	152	0–66 mos.	.794	.020			
Freeman, Holzinger and Mitchell (1928)	74	4 years	.68	.042	Mean Gain 2.5		8 years at test one. 12–2 at retest
Matthew and Luckey	50	1–2 years	.92	.01			
	100		.74	.03			
Rogers, Durling, and McBride (1928)	44	½–5½ years	.78	.04			
	20	½–5½ years	.89	.05			
	28	2–4 years Md. 2–5 mos.	.75	.05	(Md. —2)	—7 to 5	5 to 8–11 Md. 6–5
	32	1–6 years Md. 3 yrs. and 8 mos.	.32	.06	(Md. —2)	—7 to 5	4 to 8–11 Md. 6–3
Carroll and Hollingworth (1930)	52	1 year	.68	.051	9.02	—3.75 to 11.50	

Cattell (1930)		1 hour to 6 yrs. Mean, 4.7 yrs.	.77				
Lamson (1930)	53	1 year	.72	.045	7.85	—3.44 to 10.38	
	43	1 year	.53	.074	9.37	—8.12 to 9.25	
	43	2 years	.606	.065	8.95	—2.56 to 13.25	
Brown (1930)	707	Mean 15 mos.	.88	.006	5.8		2–18 years. Mean 10.5. 67 per cent between 7 and 14 years
	149	Range a few weeks	.87	.013			
	149	to over 4 years	.70	.028			
	129	1 yr. or less	.91	.007			
	320	2 years but less than 3	.87	.009			
	449	3 yrs. and less	.88	.015			
	41	4 years but less than 5	.87	.02			
	83		.81	.026			I.Q.'s below 60
	475		.68	.017			I.Q.'s 61–90
	148		.61	.03			I.Q.'s above 90
	458		.88	.007			Boys
	248		.87	.010			Girls
Burks, Jensen, Terman (1930)	54	6 years	.60*	.10			8–13 years of age at retest
			.81				
			.77				
	73	6 years	.65	.09			

* Baldwin and Stecher have presented data in various sources (27, 61, 62); however, they have not presented sufficient data to include in this table. The data in this table were taken from source (27) and worked over to show various I.Q. changes. The first mean change and the first middle 50 per cent of change indicate algebraic changes; the bottom figures in each instance represent changes regardless of signs.

The data included in the study by Garrison and Robinson are based upon I.Q.'s with the exception of the correlations which, according to the authors, involve scores.

Burks, Jensen, and Terman used three methods to find the correlation between the initial and second I.Q. ratings for a group of 54 children.

C. Group Tests

Garrison and Robinson (126), Olson (50), Johnson (151), Shewman (206), Wentworth (54), Broom (75, 76), Jordan (152), Hirsch (43), Burks, Jensen, and Terman (1), Porter and Lauderbach (247), and Nettels (177) have studied the constancy of the I.Q. with various group tests. The results of their studies are shown in Table IV.

On the whole, these researches have been reported rather meticulously; however, there is a lack of uniformity in specifying changes in intelligence quotients. Many of the criticisms applicable to studies using individual mental examinations may be justifiably used in reviewing group test investigations. Another peculiar circumstance throughout the literature devoted to the constancy of the I.Q. is that only one attempt has been made to correct for practice effects. Olson (50) corrected for practice in his research. He concluded, "The actual median change in I.Q. when Delta 2 is repeated at a year interval is 7.4 points. With allowance for practice the change becomes plus 2.46 points." That this is an important issue has been shown by Miller (174) and Kefauver (154).

Other investigators who have data pertaining to the constancy of the I.Q. as derived from group tests are Cattell (79), Cattell and Gaudet (81), Avery (58), Cole (88), Cowdery (91), Dearborn and Long (100), Garrison and Tippett (127), Kefauver (154), Miller (174), Rogers (196), Root (199), Steckel (214), Colvin (89), Gates (128), Guiler (138, 139), Brooks (73), Pintner (184), and Stenquist (53, 211).

D. Practice, Coaching, Training, Environment, and the I.Q.

From a review of studies by Casey, Davidson, and Harter (17), Denworth (18), Burks (14, 15), Freeman, Holzinger, and Mitchell (19), Goodenough (20), Greene (21), Hildreth (22), Rogers, Durling, and McBride (25), Chen (29), Coy (30), Glick (39), Graves (42), Marine (48), Barrett and Koch (64), Bishop (68), Chapman (82), Chauncey (83), De Weerdt (102), Dunlap and Snyder (106), Freeman (116, 117), F. S. Freeman (121), Gilmore (130), Hurlock (146), Ide (147), Merriman (173), Odell (179), Renshaw (192), Richardson and Robinson (193), Saer (205), Teagarden (217), Terman (219), Thorndike (221), Wechsler (233), Wells (234), White (236), and Slocombe (208) concerning the effects of practice, coaching, length of school attendance, environment, nursery school or kindergarten attendance, familiarity of the

TABLE IV

THE CONSTANCY OF THE I.Q. DERIVED FROM GROUP TESTS

Experimenter Date Reported	Tests Used	N	Testing Interval	Grade or Age Range	r	P.E.	Changes in I.Q.'s on Retests
Johnson (1923)	Terman Group Test	37	1 yr.	VII—1	.95	.01	
		32	1 yr.	VII—2	.94	.009	
		169	1 yr.	VIII—1	.87	.015	
Olson (1924)	Haggerty Delta 2	56	14 mos.	4, 5, 6, 7, 8 Grades	.866	.021	Median, 6.4 P.E., 4.15 S.D., 6.67 Aver., 7.52
	Haggerty Delta 2	609	15 mos.	8–19 yrs. 3–10 Grs.	.91 (Scores) .81 (I.Q.'s)	.005 .009	Median, 7.4 P.E., 6.5 Range of middle 50 per cent of changes, 1.78 to 10.7 Aver., 7.1
Garrison and Robinson* (1925)	Nat. Int. Test, Form A1 for Tests 1 & 2; Form A2 for Test 3	140	10 mos.	Grs. 3–8	.90	.011	—6 to 6, the range of middle 50 per cent of change
		131	20 mos.	Ages 8-5 to 15-3	.91	.010	—7 to 7
		131	10 mos.	Ages 8-5 to 15-3	.93	.01	Average gain, 3.7 over 20 mos.
Shewman (1926)	Terman Group Test, Forms A & B	229	3 yrs. 4 mos.	H. S.	.72 (I.Q.'s) .77 (Scores)	.02 .02	
Wentworth (1926)	Dearborn A	575	1 yr.	Gr. 1 at Test 1; Gr. 2 at Test 2	.72	.013	Average, 9 Median, 5 $P.E._{(M)}$, 4.95

TABLE IV (Continued)

Experimenter Date Reported	Tests Used	N	Testing Interval	Grade or Age Range	r	P.E.	Changes in I.Q.'s on Retests
Broom (1927)	Terman Group Test	50	6 mos. to 1 yr. 11 mos.	H. S.	.862	.026	Range of change, —13 to 8
Broom (1930)	Otis-Self Adm. Test of Mental Ability, Higher Exam., A	212	5 mos.		.83	.014	Range of change, —16 to 22
Jordan (1930)	Nat. Int. Test, 6 testings	183	6 mos.	Grs. 3–7			Median gain, 9.1
Burks, Jensen, Terman (1930)	Terman Group Test	26	.2 yr.	14.5 yrs. at Test 1; 14.7 yrs. at Test 2	.62 (I.Q.'s)	.08	Average, 10.96 Q., 6.0
					.87 (Scores)	.03	Range, —14 to 29 Middle 50 per cent, 3.5 to 15.5
Miller (Unpub.)	Miller Mental Ability Test, Form A vs. B	57	10 mos.	H. S. Freshmen. Median C. A., 13–7; S. D. of C. A., 10	.90	.017	
Hirsch (1930)	Tests in order were Otis Primary Test, Forms A, B, A; Otis Adv., A, B, A	343	9–15 mos. Average, 1 yr.	Grs. 1 & 2 at 1st Testing			
							All below changes are averages
	1 & 2	322			.83	.01	6.7
	2 & 3	252			.89	.008	5.6

	3 & 4	277			.84	.011	7.5
	4 & 5	257			.88	.009	7.5
	5 & 6	*225			.94	.005	7.6
	1 & 6	244			.794	.016	
Porter and Lauderbach (1931)	Pintner - Cunningham Primary Mental Test	193	6–17 mos.	Kindergarten and Primary Children	.718	.02	Range of change, —29 to 35

* Garrison and Robinson correlated scores, not I.Q.'s; however, the other data refer to I.Q.'s.

Hirsch reported the correlation between tests 5 and 6 for 225 cases; but when he calculated the average change in I.Q. for tests 5 and 6 he used 230 cases.

examiner, and specialized training on mental ability, one may conclude that the I.Q., as measured or determined by our present testing instruments, may be changed to a certain extent; however, the changes which are due to practice, training, and the like tend to be of a transient nature. In other words, after an interval of time elapses, fluctuations in the I.Q. due to these factors seem to disappear.

E. Physical Condition and the Constancy of the I.Q.

Researches on this phase of the problem by Hoefer and Hardy (**23**), Dawson and Conn (**31**), Rogers (**51**), Fox (**113**), Jewett and Blanchard (**150**), Lowe (**167**), De Weerdt (**101**) and others have shown that the I.Q. is relatively constant. These studies have disproved the idea that the I.Q. would increase significantly following improvement in physical condition.

F. Concluding Remarks

In concluding, it may be in order to note that the results from studies concerning the constancy of the I.Q. present a high degree of consistency. As one method of comparing the results of individual examinations with those of group tests, the reliability coefficients found by correlating test and retest I.Q.'s may be arranged into a frequency distribution as follows:

r's	f (Stanford-Binet)	f (Group)*
.95 — .99	5	1
.90 — .94	15	3
.85 — .89	20	9
.80 — .84	23	6
.75 — .79	12	3
.70 — .74	9	4
.65 — .69	8	0
.60 — .64	3	1
.55 — .59	1	0
.50 — .54	1	0
N	97	27
Median	.832	.846
Q_3	.889	.885
Q_1	.76	.779
Q	.0645	.053

* In addition to the reliability coefficients between test and retest I.Q.'s presented in Tables III and IV, the distribution of r's contains a number of coefficients from the studies of Baldwin and Stecher (**27, 61**) and Olson (**50**).

The validity of this comparison may be readily questioned; however, it is merely presented to show that there is a rather wide range in the magnitude of the reliability coefficients for Stanford-Binet

Tests as well as for various group tests. Furthermore, it is important that one consider the groups studied by the various investigators. As a matter of fact, the extremely low coefficients reported for the Stanford-Binet Tests were not found for unselected groups. In the last analysis, however, the magnitude of the reliability coefficients for group tests tends to be as high as for individual tests, casting doubt upon the conception of the gross unreliability of group testing methods.

BIBLIOGRAPHY

1. Books

1. Burks, B. S., Jensen, D. W., and Terman, L. M., *Genetic Studies of Genius. III. The Promise of Youth.* Palo Alto: Stanford University Press, 1930. Pp. 508.
2. Claremont, C. A., *Intelligence and Mental Growth.* New York: Norton, 1928. Pp. 120.
3. Cox, C. M., *Genetic Studies of Genius. II. The Early Mental Traits of Three Hundred Geniuses.* Palo Alto: Stanford University Press, 1926. Pp. 842.
4. Dickson, V. E., *Mental Tests and the Classroom Teacher.* New York: World Book Co., 1923. Pp. 231.
5. Freeman, F. N., *Mental Tests.* Boston: Houghton Mifflin Co., 1926. Pp. 503.
6. Irwin, E. A., and Marks, L. A., *Fitting the School to the Child.* New York: The Macmillan Co., 1924. Pp. 339.
7. Johnson, B. J., *Mental Growth of Children in Relation to the Rate of Growth in Bodily Development.* New York: E. P. Dutton & Co., 1925. Pp. 160.
8. Paterson, D. G., *Physique and Intellect.* New York: The Century Co., 1930. Pp. 304.
9. Pintner, R., *Intelligence Testing, Methods and Results.* New York: Henry Holt and Co., 1923, 406 pp.; 1931, 555 pp.
10. Terman, L. M., *The Intelligence of School Children.* Boston: Houghton Mifflin Co., 1919. Pp. 317.
11. Terman, L. M., *The Measurement of Intelligence.* New York: Houghton Mifflin Co., 1916. Pp. 362.
12. Terman, L. M., *The Stanford Revision and Extension of the Binet-Simon Scale for Measuring Intelligence.* Baltimore: Warwick and York, 1917. Pp. 179.
13. Woodrow, H., *Brightness and Dullness in Children.* Chicago: J. B. Lippincott Co., 1919. Pp. 322.

2. Yearbooks

14. Burks, B. S., "Comments on the Chicago and Stanford Studies of Foster Children." Pp. 317–323. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

15. BURKS, B. S., "The Relative Influence of Nature and Nurture Upon Mental Development; A Comparative Study of Foster Parent-Foster Child Resemblance and True Parent-True Child Resemblance." Pp. 219–317. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

16. BURKS, B. S., "A Summary of Literature on the Determiners of the Intelligence Quotient and the Educational Quotient." Pp. 319–325. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part II. Bloomington, Illinois: Public School Publishing Co., 1928.

17. CASEY, M. L., DAVIDSON, H. P., and HARTER, D. I., "Three Studies on the Effect of Training in Similar and Identical Material Upon Stanford-Binet Scores." Pp. 431–441. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

18. DENWORTH, K. M., "The Effect of Length of School Attendance Upon Mental and Educational Ages." Pp. 67–93. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part II. Bloomington, Illinois: Public School Publishing Co., 1928.

19. FREEMAN, F. N., HOLZINGER, K. J., and MITCHELL, B. C., "The Influence of Environment on the Intelligence, School Achievement, and Conduct of Foster Children." Pp. 103–219. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

20. GOODENOUGH, F. L., "A Preliminary Report on the Effect of Nursery School Training Upon the Intelligence Test Scores of Young Children." Pp. 361–371. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

21. GREENE, K. B., "The Influence of Specialized Training on Tests of General Intelligence." Pp. 421–431. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

22. HILDRETH, G., "The Effect of School Environment Upon Stanford-Binet Tests of Young Children." Pp. 355–361. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

23. HOEFER, C., and HARDY, M. C., "The Influence of Improvement in Physical Condition on Intelligence and Educational Achievement." Pp. 370–387. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

24. MATTHEW, J., and LUCKEY, B., "Notes on Factors that May Alter the Intelligence Quotient in Successive Examinations." Pp. 411–421. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

25. ROGERS, A. L., DURLING, D., and MCBRIDE, K., "The Effect on the Intelligence Quotient of Change from a Poor to a Good Environment." Pp. 323–333. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1928.

26. Twenty-Seventh Yearbook of the National Society for the Study of Education, Part I, 465 pp.; Part II, 397 pp. Bloomington, Illinois: Public School Publishing Co., 1928.

3. MONOGRAPHS AND BULLETINS

27. BALDWIN, B. T., and STECHER, L. I., "The Mental Growth of Normal and Superior Children Studied by Means of Consecutive Intelligence Examinations." University of Iowa Studies in Child Welfare, Vol. 2, No. 1. Iowa City, Iowa: University of Iowa Bureau of Publications, Jan., 1922. Pp. 60.

28. BROOKS, F. D., "Changes in Mental Traits with Age Determined by Annual Retests." Teachers College Contributions to Education, No. 116. New York: Bureau of Publications, Teachers College, Columbia University, 1921. Pp. 86.

29. CHEN, H. S., "The Comparative Coachability of Certain Types of Intelligence Tests." Teachers College Contributions to Education, No. 338. New York: Bureau of Publications, Teachers College, Columbia University, 1928.

30. COY, G., "The Interests, Abilities, and Achievements of Gifted Children." Teachers College Contributions to Education, No. 131. New York: Bureau of Publications, Teachers College, Columbia University, 1923.

31. DAWSON, S., and CONN, J. C. M., "Effect of Encephalitis Lethargica on the Intelligence of Children." Archives of the Diseases of Childhood, Vol. 1. New York, 1926. Pp. 257–368.

32. DOLL, E. A., "Growth of Intelligence." Psychological Review Supplementary Monograph, Vol. 29, No. 2, 1921.

33. DOUGHERTY, M. L., "A Comparative Study of Nine Group Tests of Intelligence for Primary Grades." The Johns Hopkins University Studies in Education, No. 10. Baltimore: Johns Hopkins Press, 1928. Pp. 112.

34. DOUGHERTY, M. L., "The Educational Clinic of the Department of Education." The Johns Hopkins University Studies in Education. Baltimore: Johns Hopkins Press, 1929. Pp. 78.

35. FERMON, M. L., "Validity of I.Q. as Established by Retests." M.A. Thesis, Columbia University, May, 1920.

36. FORAN, T. G., "The Constancy of the Intelligence Quotient; A Review." Educational Research Bulletins, Vol. 1, No. 10. Department of Education, Catholic University of America. Washington, D. C.: Catholic Education Press, Dec., 1926. Pp. 40.

37. FORAN, T. G., "A Supplementary Review of the Constancy of the Intelligence Quotient." Educational Research Bulletins, Vol. 4, No. 9. Dept. of Education, Catholic University of America. Washington, D. C.: Catholic Education Press, 1929.

38. FURFEY, P. H., "A Selected Bibliography on Child Development." Educational Research Bulletins, Vol. 4, No. 4, Dept. of Education, Catholic University of America. Washington, D. C.: Catholic Education Press, April, 1929. Pp. 51.

39. GLICK, H. N., "Effect of Practice on Intelligence Tests." University of Illinois Bulletin, No. 27. Urbana, Illinois: Bureau of Educational Research, University of Illinois, 1925.

40. GOODENOUGH, F. L., "The Kuhlmann Binet Tests for Children of Pre-School Age: A Critical Study and Evaluation." University of Minnesota Institute of Child Welfare Monograph Series, No. 2. Minneapolis: University of Minnesota Press, 1927.

41. GOODENOUGH, F. L., "Measurement and Prediction of Mental Growth." Third Conference on Research in Child Development, 1929. Pp. 118–136.

42. GRAVES, K. B., "The Influence of Specialized Training on Tests of General Intelligence." Teachers College Contributions to Education, No. 143. New York: Bureau of Publications, Teachers College, Columbia University.

43. HIRSCH, N. D. M., "An Experimental Study Upon Three Hundred School Children Over a Six Year Period." Genetic Psychology Monographs, No. 6, 7: 487–549. Worcester: Clark University Press, June, 1930.

44. KEYS, NOEL, "The Improvement of Measurement Through Cumulative Testing." Teachers College Contributions to Education, No. 321. New York: Bureau of Publications, Teachers College, Columbia University, 1928. Pp. 81.

45. KUHLMANN, F., "A Revision of the Binet-Simon System for Measuring the Intelligence of Children." Jour. of Psycho-Asthenics, Monograph Supplements, Sept., 1912.

46. LAMSON, E. E., "A Study of Young Gifted Children in Senior High School." Teachers College Contributions to Education, No. 424. New York: Bureau of Publications, Teachers College, Columbia University, 1930. Pp. 117.

47. LATSHAW, H. F., "Measurement of Physical Growth." Thesis, Graduate School of Education, Harvard University, 1925.

48. MARINE, E. L., "The Effect of Familiarity with the Examiner Upon Stanford-Binet Test Performance." Teachers College Contributions to Education. New York: Bureau of Publications, Teachers College, Columbia University, 1929. Pp. 42.

49. MARTIN, A. H., "What Is the I.Q.?" Sydney Univ. Repr., 1924, Series 12. Pp. 3.

50. OLSON, W. C., "The Constancy and Reliability of an Intelligence Quotient Determined by the Haggerty Intelligence Examination, Delta 2." M.A. Thesis, University of Minnesota, June, 1924. Pp. 87.

51. ROGERS, M. C., "Adenoids and Diseased Tonsils, Their Effect on General Intelligence." Archives of Psychology, No. 50. New York, 1922. Pp. 70.

52. ST. JOHN, C. W., "Educational Achievement in Relation to Intelligence." Cambridge: Harvard University Press, 1930. Pp. 219.

53. STENQUIST, J. L., "Unreliability of Individual and Group Intelligence Tests in Grades 1, 2, and 3." Unpublished Material, 1920.
54. WENTWORTH, M. M., "Individual Differences in the Intelligence of School Children." Harvard Studies in Education, No. 7. Cambridge: Harvard University Press, 1926. Pp. 162.
55. WOODYARD, E., "The Effect of Time Upon Variability." Teachers College Contributions to Education, No. 216. New York: Bureau of Publications, Teachers College, Columbia University, 1926. Pp. 56.
56. WOOLLEY, H. T., and FERRIS, E., "Diagnosis and Treatment of Young School Failures." Bureau of Education Bulletin, No. 1. Washington, 1923. Pp. 115.

4. PERIODICALS

57. ANDERSON, M. L., "A Study of the Data on the Results Gathered from Repeated Mental Examinations of 200 Defective Children Attending Special Schools Over a Period of Eight Years." *Journal of Applied Psychology*, **7**: 54–64, 1923.
58. AVERY, G. T., "A Study of the Binet and Terman Intelligence Tests with Eleven-Year Old Children." *Journal of Educational Research*, **7**: 429–434, May, 1923.
59. BAGLEY, W., "Educational Determinist and the I.Q." *School and Society*, **15**: 373–384, April 8, 1922.
60. BALDWIN, B. T., "Child Psychology, A Review of the Literature, January 1, 1923, to March 31, 1928." *Psychological Bulletin*, **25**: 629–697, 1928.
61. BALDWIN, B. T., and STECHER, L. I., "Additional Data from Consecutive Stanford Binet Tests." *Journal of Educational Psychology*, **13**: 556–560, Dec., 1922; also in the *Journal of Educational Research*, **8**: 375, Nov., 1923.
62. BALDWIN, B. T., and STECHER, L. I., "The Fluctuations of the I.Q. of Normal and Superior Children at Successive Examinations." *Psychological Bulletin*, **18**: 99–100, Feb., 1921.
63. BALLARD, P. B., "The Limit of Growth of Intelligence." *British Journal of Psychology*, **12**: 125–141, Oct., 1921.
64. BARRETT, H. E., and KOCH, H. L., "The Effect of Nursery-School Training Upon the Mental Test Performance of a Group of Orphanage Children." *Journal of Genetic Psychology*, **37**: 102–122, March, 1930.
65. BAYLEY, N., "The Consistency of Mental Growth During the First Year." *Program of the 38th Annual Meeting of the American Psychological Association*, pp. 38–39, Dec., 1930.
66. BERRY, C. S., "Eighty-Two Children Retested by the Binet Tests of Intelligence." *Psychological Bulletin*, **10**: 77–78, Feb., 1913.
67. BERRY, C. S., "The Intelligence Quotients of Mentally Retarded School Children." *School and Society*, **17**: 723–729, 1923.
68. BISHOP, O., "What Is Measured by Intelligence Tests?" *Journal of Educational Research*, **9**: 29–39, Jan., 1924.
69. BLOCH, E., and LIPPA, H., *Zeitschrift f. Angewandte Psych.*, **7**: 397–409, 1912.

70. Bobertag, O., "Ueber Intelligenzprüfungen." *Zeitschrift f. Angewandte Psych.*, **6**: 495–538, 1912.

71. Bronner, A. F., "Attitude as it Affects Performance of Tests." *Psychological Review*, **23**: 303–331, 1916.

72. Brooks, F. D., "The Accuracy of the Abbreviated Stanford-Binet Intelligence Scale." *Psychological Clinic*, **18**: 17–20, 1929.

73. Brooks, F. D., "The Accuracy of Intelligence Quotients from Pairs of Group Tests in the Junior High School." *Journal of Educational Psychology*, **18**: 173–186, 1927.

74. Brooks, F. D., "Rate of Mental Growth, Ages Nine to Fifteen." *Journal of Educational Psychology*, **12**: 502–510, Dec., 1921.

75. Broom, E., "Constancy of the I.Q." *School and Society*, **25**: 295–296, March 5, 1927, No. 636.

76. Broom, M. E., "How Constant Is the I.Q. Yielded by the Otis Self-Administering Test of Mental Ability?" *Journal of Educational Research*, **22**: 53–55, 1930.

77. Brown, A. W., "The Change in Intelligence Quotients in Behavior Problem Children." *Journal of Educational Psychology*, **21**: 341–350, May, 1930.

78. Carroll, H. A., and Hollingworth, L. S., "The Systematic Error of Herring Binet in Rating Gifted Children." *Journal of Educational Psychology*, **21**: 1–12, Jan., 1930.

79. Cattell, P., "Comparability of I.Q.'s Obtained from Different Tests at Different I.Q. Levels." *School and Society*, **31**: 437–442, March 29, 1930.

80. Cattell, P., "I.Q.'s and the Otis Measure of Brightness." *Journal of Educational Research*, **22**: 31–35, 1930.

81. Cattell, P., and Gaudet, F. J., "The Inconstancy of the I.Q. as Measured by Repeated Group Tests." *Journal of Educational Research*, **21**: 21–29, Jan., 1930.

82. Chapman, A. E., "The Effect of School Training and Special Coaching on Intelligence Tests." *Forum of Education*, **2**: 172–183, Nov., 1925.

83. Chauncey, M. R., "The Relation of the Home Factor to Achievement and Intelligence Test Scores." *Journal of Educational Research*, **20**: 88–90, Sept., 1929.

84. Chipman, C. E., "The Constancy of the Intelligence Quotient of Mental Defectives." *Psychological Clinic*, **18**: 103–111, 1929.

85. Chotzen, F., and Nicolauer, M., "Die Intelligenzprüfungsmethode von Binet-Simon bei Schwachsinnigen Kindern." *Zeitschrift f. Angewandte Psych.*, **6**: 411–494, 1912.

86. Claparède, E., "De la Constance des Sujets a l'Egard des Tests d'Aptitude." *Arch. de Psych.*, **17**: 325–334, 1922.

87. Cobb, M. V., "One Element in the Probable Error of a Mental Age Measurement." *Journal of Educational Psychology*, **13**: 236–240, 1922.

88. Cole, R. D., "A Conversion Scale for Comparing Scores on Three Secondary School Intelligence Tests." *Journal of Educational Research*, **20**: 190–199, Oct., 1929.

89. COLVIN, S. S., "Some Recent Results Obtained from the Otis Group Intelligence Scale." *Journal of Educational Research,* **3**: 1–12, Jan., 1921.

90. CORNELL, E. L., "Taking the Dogma Out of the I.Q." *Mental Hygiene,* **11**: 804–810, 1927.

91. COWDERY, K. M., "Repeated Thorndike Intelligence Examinations." *School and Society,* **27**: 367–369, March 24, 1928.

92. CUFF, N. B., "Is the I.Q. Constant?" *Peabody Journal of Education,* **8**: 32–35, July, 1930, No. 1.

93. CUNEO, I., and TERMAN, L. M., "Stanford Binet Tests of 112 Kindergarten Children and 77 Repeated Tests." *Pedagogical Seminary,* **25**: 414–428, 1918.

94. CURETON, E. E., "The Measurement of Brightness." *Journal of Educational Psychology,* **19**: 88–98, 1928.

95. CURETON, E. E., and DUNLAP, J. W., "A Nomograph for Estimating the Reliability of a Test in One Range of Talent When Its Reliability is Known in Another Range." *Journal of Educational Psychology,* **20**: 537–538, 1929.

96. CUSHMAN, C. L., "A Study of the Reliability of Mental Tests as Used in Oklahoma City." *Journal of Applied Psychology,* **11**: 509–511, 1927.

97. DAVIDSON, F. A., "Interpretations of the Curve of Normal Growth." *Science,* **72**: 226, 1930.

98. DEARBORN, W. F., "Intelligence Quotients of Adults and Related Problems." *Journal of Educational Research,* **6**: 307–326, Nov., 1922.

99. DEARBORN, W. F., "Repeated Measurements of the Physical and Mental Development of School Children." *School and Society,* **20**, No. 513, Oct. 25, 1924.

100. DEARBORN, W. F., and LONG, H. H., "On Comparing I.Q.'s at Different Age Levels on the Same Scale." *Journal of Educational Research,* **18**: 265–274, Nov., 1928.

101. DE WEERDT, E. H., "The Effect of Malnutrition Upon Expression of Intelligence." *School and Society,* **27**: 540–541, May 5, 1928.

102. DE WEERDT, E. H., "The Transfer Effect of Practice in Related Functions Upon a Group Intelligence Test." *School and Society,* **25**: 438–440, 1927.

103. DOLL, E. A., "The Average Mental Age of Adults." *Journal of Applied Psychology,* **3**: 317–328, Dec., 1919.

104. DOUGHERTY, M. L., "What Changes the I.Q.?" *Elementary School Journal,* **29**: 114–121, Oct., 1928.

105. DOWNEY, J. E., "The Constancy of the I.Q." *Journal of Delinquency,* **3**: 122–129, 1918.

106. DUNLAP, K., and SNYDER, A., "Practice Effects in Intelligence Tests." *Journal of Experimental Psychology,* **3**: 396–403, Oct., 1920.

107. DVORAK, A., "The Relation of I.Q. to the Prognosis of Special Class Pupils." *School and Society,* **19**: 736–744, 1924.

108. ENGLISH, H. B., "The Predictive Value of Intelligence Tests." *School and Society,* **26**: 783, 1927.

109. FARNSWORTH, P. R., "Concerning So-called Group Effects." *Journal of Genetic Psychology,* **35**: 587–594, 1928.

110. FORAN, T. G., "The Cessation of Intellectual Development." *Catholic Educational Review,* **24**: 272–283, 1926.

111. FORAN, T. G., "The Constancy of the Intelligence Quotient." *Catholic Educational Review,* **24**: 135–144, 1926.

112. FORD, C. A., "The Variability of I.Q.'s for Psychopaths Retested Within Fifteen Days." *Psychological Clinic,* **18**: 199–204, 1929.

113. FOX, E. J., "An Investigation of the Effect of Glandular Therapy on the I.Q." *Mental Hygiene,* **12**: 90–102, 1928.

114. FRANZEN, R., "Statistical Issues." *Journal of Educational Psychology,* **15**: 367–383, Sept., 1924.

115. FREEMAN, F. N., "Comments on Professor Peterson's Criticism." *Journal of Educational Psychology,* **12**: 155–159, March, 1921.

116. FREEMAN, F. N., "The Effect of Environment on Intelligence." *School and Society,* **31**: 623–633, May 10, 1930.

117. FREEMAN, F. N., "An Evaluation of the Evidence in Part I of the Yearbook and Its Bearing on the Interpretation of Intelligence Tests." *Journal of Educational Psychology,* **19**: 374–380, 1928.

118. FREEMAN, F. N., "The Interpretation and Application of the I.Q." *Journal of Educational Psychology,* **12**: 3–14, Jan., 1921.

119. FREEMAN, F. N., "Mental Tests." *Psychological Bulletin,* **17**: 353–362, Nov., 1920.

120. FREEMAN, F. N., "Tests." *Psychological Bulletin,* **10**: 271–274, 1913; **11**: 253–256, 1914; **12**: 187–188, 1915; **13**: 268–271, 1916; **14**: 245–249, 1917; **16**: 374–381, 1919.

121. FREEMAN, F. S., "Influence of Educational Attainment Upon Tests of Intelligence." *Journal of Educational Psychology,* **19**: 230–242, 1928.

122. GARRISON, S. C., "Additional Retests by Means of the Stanford Revision of the Binet Simon Tests." *Journal of Educational Psychology,* **13**: 307–312, 1922.

123. GARRISON, S. C., "Fluctuation of the I.Q." *School and Society,* **13**: 647–649, 1921.

124. GARRISON, S. C., "Retests on Adults at an Interval of Ten Years." *School and Society,* **32**: 326–328, Sept. 6, 1930.

125. GARRISON, S. C., "Yerkes's Point Scale for Measuring Mental Ability as Applied to Normal Adults." *School and Society,* **5**: 747–750, 1917.

126. GARRISON, S. C., and ROBINSON, M. S., "A Study of Retests." *Journal of Educational Research,* **11**: 190–196, March, 1925.

127. GARRISON, S. C., and TIPPETT, J. S., "Comparison of the Binet Simon and Otis Tests." *Journal of Educational Research,* **6**: 42–49, June, 1922.

128. GATES, A. I., "The Unreliability of M.A. and I.Q. Based on Group Tests of General Mental Ability." *Journal of Applied Psychology,* **7**: 93–100, March, 1923.

129. GESELL, A., "The Measurement and Prediction of Mental Growth." *Psychological Review,* **34**: 385–390, 1927.

130. GILMORE, M. E., "Coaching for Intelligence Tests." *Journal of Educational Psychology,* **18**: 119–121, 1927.

131. GODDARD, H. H., "Three Annual Testings of 400 Feeble-minded Children and 500 Normal Children." *Psychological Bulletin,* **10**: 75–77, Feb., 1913.

132. GOODENOUGH, F. L., "The Relation of the Intelligence of Pre-School Children to the Education of Their Parents." *School and Society,* **26**: 54–56, July 9, 1927.

133. GORDON, K., "Some Retests with the Stanford Binet Scale." *Journal of Educational Psychology,* **13**: 363–365, 1922.

134. GRAY, P. L., and MARSDEN, R. E., "The Constancy of the Intelligence Quotient." *British Journal of Psychology,* **13**: 315–324, Jan., 1923.

135. GRAY, P. L., and MARSDEN, R. E., "The Constancy of the I.Q.: Final Results." *British Journal of Psychology,* **17**: 20–26, 1926.

136. GRAY, P. L., and MARSDEN, R. E., "The Constancy of the Intelligence Quotient—Further Results." *British Journal of Psychology,* **15**: 169–174, Oct., 1924.

137. GRAY, P. L., and MARSDEN, R. E., "The Stanford Binet Tests in Some English Schools." *Journal of Educational Research,* **8**: 150–156, Sept., 1923.

138. GUILER, W. S., "How Different Mental Tests Agree in Rating Children." *Elementary School Journal,* **22**: 734–744, June, 1922.

139. GUILER, W. S., "The Predictive Value of Group Intelligence Tests." *Journal of Educational Research,* **16**: 365–375, Dec., 1927.

140. HAGGERTY, M. E., "Intelligence Examination Delta 2." *Journal of Educational Psychology,* **14**: 257–276, May, 1923.

141. HART, H., "The Slowing Up of Growth in Mental Test Ability." *School and Society,* **19**: 573–574, Nov. 1, 1924.

142. HEINIS, H., "La Loi du Développement Mentale." *Archives de Psychologie,* **19**: 97, 1924.

143. HEINIS, H., "A Personal Constant." *Journal of Educational Psychology,* **17**: 163, 1926.

144. HENMON, V. A. C., and BURNS, H. M., "The Constancy of I.Q.'s With Borderline and Problem Cases." *Journal of Educational Psychology,* **14**: 247–250, 1923.

145. HILDRETH, G., "Stanford Binet Retests of 441 School Children." *Pedagogical Seminary,* **33**: 365–386, Sept., 1926.

146. HURLOCK, E. B., "The Effect of Incentives Upon the Constancy of the I.Q." *Pedagogical Seminary,* **32**: 422–434, Sept., 1925.

147. IDE, G. G., "The Increase of the Intelligence Quotient Through Training." *Psychological Clinic,* **14**: 159–162, 1922.

148. JANSSON, A., "Intelligensprovens Konstans." (The Constancy of the Intelligence Test.) *Ark. f. Psykol. o. Ped.,* **7**: 125–152, 1928.

149. JANSSON, A., "Om Orsakerna Till Intelligensprovens Bristande Konstans." (Causes for the Inadequate Constancy of Intelligence Tests.) *Ark. f. Psykol. o. Ped.,* **8**: 132–159, 1929.

150. JEWETT, S. P., and BLANCHARD, P., "Influence of Affective Disturbances on Responses to the Stanford Binet Test." *Mental Hygiene,* **6**: 39–56, 1922.

151. JOHNSON, O. J., "Data on the Repetition of Certain Mental Tests." *Journal of Educational Research,* **7**: 458–460, May, 1923.

152. JORDAN, A. M., "Mental Growth." *Journal of Applied Psychology,* **14**: 517–532, Dec., 1930, No. 6.
153. KEEN, A. M., "Growth Curves and I.Q.'s as Determined by Testing Large Families." *School and Society,* **32**: 737–742, Nov. 29, 1930.
154. KEFAUVER, G. N., "Need of Equating I.Q.'s Obtained from Group Tests." *Journal of Educational Research,* **19**: 92–102, Feb., 1929.
155. KUHLMANN, F., "Binet and Simon's System for Measuring the Intelligence of Children." *Journal of Psycho-Asthenics,* 1911.
156. KUHLMANN, F., "Degree of Mental Deficiency in Children as Expressed by the Relation of Age to Mental Age." *Journal of Psycho-Asthenics,* June, 1913.
157. KUHLMANN, F., "The Results of Repeated Mental Re-examinations of 639 Feeble-minded Over a Period of Ten Years." *Journal of Applied Psychology,* **5**: 195–224, 1921.
158. KUHLMANN, F., "Some Results of Examining a Thousand Public School Children with a Revision of the Binet-Simon Tests." *Journal of Psycho-Asthenics,* March and June, 1914.
159. KUHLMANN, F., "What Constitutes Feeble-mindedness?" *Journal of Psycho-Asthenics,* pp. 214–236, 1915.
160. LANIER, L. H., "Prediction of the Reliability of Mental Tests and Tests of Special Abilities." *Journal of Experimental Psychology,* **10**: 69–113, April, 1927.
161. LEAHY, S. R., and Fox, E. J., "An Investigation of the Effect of the Emotional Factor on the Intelligence Quotient." *Journal of Juvenile Research,* **14**: 260–266, 1930.
162. LINCOLN, E. A., "The Constancy of I.Q.'s (A Case Study)." *Journal of Educational Psychology,* **13**: 484–495, 1922.
163. LINCOLN, E. A., "The Mental Age of Adults." *Journal of Educational Research,* **6**: 133–145, Sept., 1922.
164. LINCOLN, E. A., "Reliability of the Stanford Binet Scale and the Constancy of Intelligence Quotients." *Journal of Educational Psychology,* **18**: 621–627, 1927.
165. LINCOLN, E. A., "Time Saving in the Stanford-Binet Test." *Journal of Educational Psychology,* **13**: 94–97, 1922.
166. LIU, N. C., "Physical and Mental Growth." *Chinese Students Quar.,* **12**: 13–33, 1927.
167. LOWE, G. M., "Mental Changes After Removing Tonsils and Adenoids." *Psychological Clinic,* **15**: 92–100, 1923–24.
168. LUH, C. W., "Formula of the Growth of Intelligence." *Chinese Educ. Rev.,* **18**, No. 7, 1926.
169. LUH, C. W., "A Note on the Relation Between the Constancy of the I.Q. and the Rate of Mental Growth." *Journal of Genetic Psychology,* **36**: 185–187, 1929.
170. LUH, C. W., "A Note on the Curve of Mental Growth." *Journal of Genetic Psychology,* **36**: 183–185, 1929.
171. MADSEN, I. N., "Some Results with the Stanford Revision of the Binet Simon Tests." *School and Society,* **19**: 559–562, 1924.
172. MATHEWS, J., "Irregularity in Intelligence Tests of Delinquents." *Journal of Delinquency,* **6**: 355–361, 1921.

173. MERRIMAN, C., "Coaching for Mental Tests." *Educational Administration and Supervision,* **13**: 59–64, 1927.

174. MILLER, W. S., "The Variation and Significance of I.Q.'s Obtained from Group Tests." *Journal of Educational Psychology,* **15**: 359–367, Sept., 1924.

175. MINOGUE, B. M., "The Constancy of the I.Q. of Mental Defectives." *Mental Hygiene,* **10**: 751–758, 1926.

176. MURDOCK, K., and SULLIVAN, L. R., "Some Evidence of an Adolescent Increase in the Rate of Mental Growth." *Journal of Educational Psychology,* **13**: 350–356, 1922.

177. NETTELS, C. H., "A Study of the Constancy of the I.Q." *Educational Research Bulletin (Los Angeles),* **6**: 9–10, Nov., 1926.

178. ODELL, C. W., "A Few Data on the Use of the Stanford Revision of the Binet-Simon Tests by Halves." *Journal of Educational Research,* **4**: 437–438, 1921.

179. ODELL, C. W., "Some Data as to the Effect of Previous Testing Upon Intelligence Scores." *Journal of Educational Psychology,* **16**: 482–486, 1925.

180. ODOM, C. L., "Study of the Mental Growth Curve with Special Reference to the Results of Group Intelligence Tests." *Journal of Educational Psychology,* **20**: 401–416, 1929.

181. OTIS, A. S., and KNOLLIN, H. E., "The Reliability of the Binet Scale and of Pedagogical Scales." *Journal of Educational Research,* **4**: 121–142, Sept., 1921.

182. PAULSEN, G. B., "A Coefficient of Trait Variability." *Program of the 38th Annual Meeting of the American Psychological Association,* pp. 28–29, Dec., 1930.

183. PETERSON, J., "The Growth of Intelligence and the I.Q." *Journal of Educational Psychology,* **12**: 148–155, March, 1921.

184. PINTNER, R., "Group Tests After Several Years." *Journal of Educational Psychology,* **16**: 391–395, 1925.

185. PINTNER, R., "Intelligence Tests." *Psychological Bulletin,* **23**: 366–382, 1926; **24**: 391–408, 1927; **26**: 381–397, 1929; **27**: 431–457, 1930.

186. PINTNER, R., "Results Outlined with the Non-Language Group Test." *Journal of Educational Psychology,* **15**: 42–48, 1924.

187. POULL, L. E., "Constancy of the I.Q. in Mental Defectives, According to the Stanford Revision of Binet Tests." *Journal of Educational Psychology,* **12**: 323–324, 1921.

188. PROUTY, R. A., "Psychological Classification Versus Clinical Diagnosis." *Psychological Clinic,* **18**: 213–220, 1929.

189. PYLE, W. H., "The I.Q. and the Individual." *School and Society,* **26**: 788–790, 1927.

190. RANDALL, F. B., "A Study on the Constancy of the I.Q." *School and Society,* **26**: 311–312, Sept. 3, 1927.

191. RAYMOND, C. S., "Intellectual Development of Morons Beyond the Chronological Age of Sixteen Years." *Proc. Amer. Asso. Study Feebleminded,* **32**: 243–248, 1927.

192. RENSHAW, S., "The Intelligence of Teachers, with a Note on Practice Effects with Intelligence Tests." *Journal of Educational Research*, **7**: 28–36, 1923.

193. RICHARDSON, F., and ROBINSON, E. S., "Effect of Practice Upon the Scores and Predictive Value of the Alpha Intelligence Examination." *Journal of Experimental Psychology*, **4**: 300–317, 1921.

194. RILEY, G. L., "A Comparison of the P.C. and the I.Q." *Psychological Clinic*, **18**: 261–265, 1930.

195. ROCKWELL, J. G., "Genius and the I.Q." *Psychological Review*, **34**: 377–384, 1927.

196. ROGERS, A. L., "The Growth of Intelligence at the College Level." *School and Society*, **31**: 693–699, May 24, 1930.

197. ROGERS, A. L., DURLING, D., and MCBRIDE, K., "The Constancy of the I.Q. and the Training of Examiners." *Journal of Educational Psychology*, **19**: 257–262, 1928.

198. ROOT, W. T., "The Intelligence Quotient from Two Viewpoints." *Journal of Applied Psychology*, **6**: 267–275, 1922.

199. ROOT, W. T., "Transmutation of Scores Between Binet Tests and Group Tests." *Journal of Educational Research*, **7**: 338–344, April, 1923.

200. ROOT, W. T., "Two Cases Showing Marked Changes in I.Q." *Journal of Applied Psychology*, **5**: 156–158, 1921.

201. ROSENOW, C., "The Stability of the Intelligence Quotient." *Journal of Delinquency*, **5**: 160–173, 1920.

202. ROSSY, C. S., and SAWYER, M. H., "Comparison of Mental Gradings by the Yerkes-Bridges Point Scale and the Binet-Simon Scale." *Pedagogical Seminary*, **23**: 452–467, 1916.

203. RUGG, H. O., and COLLOTON, C., "Constancy of the Stanford Binet I.Q. as Shown by Retests." *Journal of Educational Psychology*, **12**: 315–322, 1921.

204. RUGG, L. S., "Retests and the Constancy of the I.Q." *Journal of Educational Psychology*, **16**: 341–343, May, 1925.

205. SAER, D. J., "An Inquiry Into the Effect of Bilingualism Upon the Intelligence of Young Children." *Journal of Experimental Pedagogy*, **6**: 232–240, 1922.

206. SHEWMAN, W. D., "A Study of the Intelligence and Achievement of the June, 1925, Graduating Class of the Grover Cleveland High School, St. Louis." *School Review*, **34**: 137–146, Feb., 1926, No. 2; 219–226, March, 1926, No. 3.

207. SLOCOMBE, C. S., "The Constancy of 'g,' General Intelligence." *British Journal of Psychology*, **17**: 93–110, Oct., 1926.

208. SLOCOMBE, C. S., "The Influence of Practice in Mental Tests." *Forum of Education*, **3**: 173–179, 1926.

209. SLOCOMBE, C. S., "Why the I.Q. Is Not, and Cannot Be Constant." *Journal of Educational Psychology*, **18**: 421–423, 1927.

210. STENQUIST, J. L., "Constancy of the Stanford Binet I.Q. as Shown by Retests." *Journal of Educational Psychology*, **13**: 54–56, 1922.

211. STENQUIST, J. L., "Unreliability of Individual Scores in Mental Measurements." *Journal of Educational Research*, **4**: 347–355, Dec., 1921.

212. STERN, W., "Der Intelligenzquotient als Mass der Kindlichen Intelligenz, Insbesondere der Unternormalen." *Zeitschrift f. Angewandte Psych.*, **11**: 1–18, 1926.

213. STERN, W., "The Theory of the Constancy of Intelligence." *Psychological Clinic*, **16**: 110–118, 1925. (Translated by H. Klüver.)

214. STECKEL, M. L., "The Restandardization of I.Q.'s of Different Tests." *Journal of Educational Psychology*, **21**: 278–283, 1930.

215. SYMONDS, P. M., "A Second Approximation of the Curve of Distribution of Intelligence of the Population of the United States, with a Note on the Standardization of the Stanford Revision of the Binet Simon Scale." *Journal of Educational Psychology*, **14**: 65–81, Feb., 1923.

216. SYMONDS, P. M., "A Study of Extreme Cases of Unreliability." *Journal of Educational Psychology*, **15**: 99–106, Feb., 1924.

217. TEAGARDEN, F. M., "Change of Environment and the I.Q." *Journal of Applied Psychology*, **11**: 289–296, 1927.

218. TEAGARDEN, F. M., "The Constancy of the I.Q. Again." *Journal of Educational Psychology*, **13**: 366–372, 1922.

219. TERMAN, L. M., "The Influence of Nature and Nurture Upon Intelligence Scores: An Evaluation of the Evidence in Part I of the 1928 Yearbook of the National Society for the Study of Education." *Journal of Educational Psychology*, **19**: 362–373, 1928.

220. TERMAN, L. M., "Mental Growth and the I.Q." *Journal of Educational Psychology*, **12**: 401–407, Oct., 1921, 325–341, Sept., 1921.

221. THORNDIKE, E. L., "Practice Effect on Intelligence Tests." *Journal of Experimental Psychology*, **5**: 101–107, 1922.

222. THORNDIKE, E. L., "On the Improvement of Intelligence Scores from Fourteen to Eighteen." *Journal of Educational Psychology*, **14**: 513–516, Dec., 1923.

223. THORNDIKE, E. L., "On the Improvement of Intelligence Scores from Thirteen to Nineteen." *Journal of Educational Psychology*, **17**: 73–76, Feb., 1926.

224. THORNDIKE, E. L., "The Significance of the Binet Mental Ages." *Psychological Clinic*, **8**: 185–189, Dec., 1914.

225. THURSTONE, L. L., and ACKERSON, L., "The Mental Growth Curve for the Binet Tests." *Journal of Educational Psychology*, **20**: 569–583, 1929.

226. TRABUE, M. R., "Some Pitfalls in the Administrative Use of Intelligence Tests." *Journal of Educational Research*, **6**: 1–12, June, 1922.

227. VAN WAGENEN, M. J., "Has the College Student Reached His Mental Maturity When He Enters College?" *School and Society*, **9**: 663–666, 1919.

228. WALLIN, J. E. W., "A Further Note on Scattering in the Binet Scale." *Journal of Applied Psychology*, **11**: 143–154, 1927.

229. WALLIN, J. E. W., "Intelligence Irregularity as Measured by Scattering in the Binet Scale." *Journal of Educational Psychology*, **13**: 140–151, 1922.

230. WALLIN, J. E. W., "The Results of Retests by Means of the Binet Scale." *Journal of Educational Psychology*, **12**: 392–400, 1921.

231. WALLIN, J. E. W., "The Value of the Intelligence Quotient for Individual Diagnosis." *Journal of Delinquency,* **4**: 109–124, May, 1919.

232. WALTERS, F. C., "Language Handicap and the Stanford Revision of the Binet Simon Tests." *Journal of Educational Psychology,* **15**: 276–284, 1924.

233. WECHSLER, D., "On the Influence of Education on Intelligence as Measured by the Binet Simon Tests." *Journal of Educational Psychology,* **17**: 248–257, April, 1926.

234. WELLS, F. L., "Effects of Instruction on Test Performance." *Journal of Genetic Psychology,* **37**: 314–317, June, 1930.

235. WHEELER, L. R., "A Study of the Mental Growth of Dull Children." *Journal of Educational Psychology,* **21**: 367–379, May, 1930.

236. WHITE, W., "The Influence of Certain Exercises in Silent Reading on Scores on the Otis Group Intelligence Test." *Elementary School Journal,* **23**: 783–786, 1923; also in *Educational Administration and Supervision,* **9**: 179–182, 1923.

237. WILE, I. S., "The Changing I.Q. in Children's Institutions." *Survey,* **61**: 89–91, 1928.

238. WILLIAMS, M. L., "The Growth of Intelligence as Measured by the Good-enough Drawing Test." *Journal of Applied Psychology,* **14**: 239–256, 1930.

239. WILNER, C. F., "An Extreme Case of Mis-measurement." *Journal of Educational Research,* **8**: 86–88, 1923.

240. WILSON, G. M., "Standard Deviation Versus Age as a Score Unit." *Journal of Educational Research,* **13**: 189–197, March, 1926.

241. WOOLLEY, H. T., "The Validity of Standards of Mental Measurement in Young Childhood." *School and Society,* **21**: 478–482, 1925.

242. YEPSEN, L. N., "The Reliability of the Goodenough Drawing Test with Feebleminded Subjects." *Journal of Educational Psychology,* **20**: 448–451, 1929.

243. ANON., "Is the 'I.Q.' Necessarily Constant?" *Eug. News,* **15**: 74, 1930.

244. BALDWIN, B. T., and STECHER, L. I., *The Psychology of the Preschool Child.* New York: D. Appleton and Co., 1925. Pp. 305.

245. DESCOEUDRES, A., "Les Tests de Binet-Simon Comme Mesure de Développement des Enfants Anormaux." *Arch. de Psychol.,* **15**: 59, 1915.

246. HOLLINGWORTH, L. S., *The Psychology of Subnormal Children.* New York: The Macmillan Co., 1920. Pp. 285.

247. PORTER, M. P., and LAUDERBACH, J. C., "On the Constancy of the I.Q." *School and Society,* **33**: 675–676, May 16, 1931, No. 855.

THE RÔLE OF SPEED IN INTELLIGENCE

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Thorndike (25, 26) has advanced the suggestion that human abilities should be measured in three respects, (1) height or level of difficulty, (2) extent or range of different tasks, and (3) speed. The relative importance of these three factors is somewhat problematical, due in part to the divergent results and conclusions which are reported in the experimental literature. The purpose of the present paper is to collect and to summarize those results which appertain principally to the significance of speed.

In 1928, McFarland (16) reviewed the experimental literature which pertained to the rôle of speed in mental ability. He noted the contradictory nature of the results, but concluded on the basis of experiments which employed the individual method of timing test items, viz., Peak and Boring (20), Clark (5), Hunsicker (12), and Gilbert (10), that there is "a vital relationship between rate and mental ability." In a later report (17) he stated that "ability to be quick is an essential part, if not one of the crucial factors in the mental reaction." However, other papers including publications subsequent to 1928 present results which cast some doubt upon these sweeping conclusions of McFarland.

(a) Speed in Motor Functions[1]

Bagley (1) was one of the first to work in this field. From one hundred seventy-five pupils he obtained measures of reaction time and compared them with class standings. He concluded that "there seems to be little direct relation between mental ability as represented by reaction-times, and mental ability as represented by class standings."

To a mixed group of fifty-one students at the University of Texas, Perrin (21) administered a series of seventeen motor tests which were chosen for the purpose of eliciting both complex and

[1] A measure of speed in the light of Thorndike's classification would be one in which level and range either are held constant or are controlled statistically. In many experiments it is found that level is assumed to be constant, due to the simplicity of the tasks chosen.

simple motor functions. No inter-correlations of the elementary functions exceeded four probable errors of the respective coefficients. The correlations among the complex tasks, reaction time, and Army Alpha scores appear below:

	Bogardus Test	Card Sorting	Coördination of Two Hands
Reaction time	.16 ± .09	.21 ± .09	—.06 ± .10
Army Alpha	.03 ± .10	.02 ± .10	.10 ± .09

With regard to the meager relationship between the simple and the complex tests, Perrin said, "It seems quite patent that motor ability is not general, but that it is somewhat definitely specialized." However, this generalization is followed by a reservation; namely, "A factor of general motor ability may exist; but if it does, it is lost in combination with other (non-motor) factors as the individual proceeds from one test to another."

The investigation of serial action by Hansen (11) entailed discrimination of position in response to auditory and visual stimuli. The reaction movement consisted of depressing one of four typewriter keys in an irregular succession. It was found that with each kind of stimulus the speed of serial action increased with practice, but the individual variability tended to decrease. The weighted correlation coefficient—a weighted average of two *r's* derived from different distributions[2]—between simple reaction to sound and serial action was r=.31; N=176. The relation of serial action to Army Alpha yielded a weighted r=.21; N=276.

Lemmon (15) compared differences in simple reactions to stimulus situations of varying complexity. One hundred reagents were employed. The reactions were made to lights, both as to position, *i.e.*, right or left, and as to number. If the greater number of lights appeared on the left side, the observer raised the left key, and *vice versa*. Reliabilities of the reaction times ranged from r=.88 to r=.95. The various reaction time measures were paired with scores on the Thorndike Intelligence Examination for High School Graduates. Speed of discriminative reaction correlated .27 to .54 with speed of simple reaction, the more difficult the discrimination the lower the correlation. Simple and discriminative reactions and the Thorndike Examination produced coefficients which ranged between .01 and .17.

Farnsworth, Seashore, and Tinker (7) measured simple reaction with a Hipp chronoscope and serial reaction with the Seashore

[2] Calculated by the reviewer.

Discrimeter. The reliabilities of these two functions were .72 and .91, respectively. Thirty-four university students acted as reagents. In addition, scores were obtained on the Otis Advanced Examination, Form A, Army Alpha, Form 6, the reading examination (Part V) of the Ohio State University College Extrance Examination, Form 10, and the Thorndike Intelligence Test. The correlation between simple reaction and serial reaction was .15. Simple reaction correlated negatively with the intelligence tests as follows: Otis —.24, Army Alpha —.22, Thorndike —.16, and Ohio State —.16. Correlations with serial reaction gave Ohio .14, Thorndike .20, Otis .30, and Alpha .53.

In an extensive study of individual differences in motor skills, Seashore (**23**) presented correlations between Thorndike test score and eight motor tests. The measures of reliability averaged .84. Speed of spool packing and serial reaction correlated —.03 and .09; N=50, respectively, with intelligence test score.

Fifty university students were tested on a serial selection unit by Campbell (**4**). The observer followed an intermittent visual stimulus which appeared randomly in four positions: up, down, right, left. A correlation between speed of the right arm and test score on the Psychological Examination of the American Council on Education was .01±.10. The inter-correlations of the gross musculatures, *i.e.*, between legs and arms, ranged between .84 and .96. The reliability coefficients were .93 or above. Hence, the writer concluded that a high degree of similarity or commonality appears to exist in the factors which determine the respective speeds of different musculatures to the same stimulus series.

Beck (**3**) included a test for speed of silent reading with measures of simple reaction, serial reaction, and intelligence. Thirty university students served as observers. Reliabilities of the simple and the serial action, and the reading tests were .93, .96, and .95, respectively. Inter-correlations among the four variables ranged between —.09 and .32. Upon the basis of these coefficients it was concluded that "speed plays a minor rôle in the determination of intelligence as it is measured by the Thorndike Entrance Examination."

(b) Speed in Serial-Verbal and Motor Functions

Hunsicker (**12**) used eighty-two students and eighty-one grade school pupils in a study of rate and level in arithmetic and sentence-completion. All of the reliability coefficients were above .75. The correlations between rate and level ranged from .25 to .50 (uncorrected for attenuation), from which Hunsicker concluded that "there

is a consistent and fair positive relationship between rate and ability." And, " Since these two functions, arithmetical ability and sentence-completion ability, are generally conceded to be indications of the mental ability we call intelligence, it is regarded as evident that the degree of relationship indicated by these correlations between rate and ability in the two functions, is indicative of the relationship between rate of mental work and level of intelligence itself."

Clark (5) investigated the relation of range, speed, and level to scores on intelligence tests. To one hundred eighty pupils he administered the Terman Group Intelligence Test, the Stanford Revision of the Binet Test, and the Otis Self-Administering Test of Mental Ability. Two measures of speed were obtained from the quickness in solving arithmetic problems and completing sentences. The reliability coefficients were .79 and .88, respectively. The correlations of rate with the scores on the intelligence tests averaged .54. But when range and level were held constant by the use of partial correlation, the average correlation between speed and intelligence *dropped* to .23.

Peak and Boring (20) gave two forms of the Army Alpha Examination and two forms of the Otis Self-Administering Test of Mental Ability to five subjects. Each item in the tests was timed by an experimenter who sat beside the subject. In addition, one hundred simple reaction-time measures of the motor type were obtained by the use of a Sanford chronoscope. The Alpha and the Otis tests correlated .70 and .90 with reaction times. The authors stated with reservations due to the number of subjects that " speed of reaction is an important, and probably the most important factor in individual differences in the intelligent act."

Dowd (6) tested the speed of reading and the speed of hand movement in one hundred sixty-five sixth grade children. The Otis Advanced Examination which had a reliability of r=.83 was given also. The reliability of the reading material was r=.83, and that of the hand movement approximated r=.88. Correlations among the component measures were as follows:

Hand movement and intelligence	$r = .10 \pm .05$
Reading and intelligence	$r = .30 \pm .05$
Hand movement and reading	$r = .34 \pm .05$

Gates (9) studied the rate of reading of eighty grade school pupils in its relation to general intelligence. Scores on the reading test correlated r=.31 with the scores on the Stanford-Binet Intelligence Test. Similarly, Beck (2) employed seventy college sopho-

mores and found a correlation of .13 between the scores of the A. C. E. Examination and measures of reading rate on the Iowa State Reading Test.

Miles and Bell (**18**) took photographic records of the eye-movements of sixteen advanced university students while they were reading a paragraph from Form T of the Thorndike Intelligence Examination for High School Graduates, Part III. Comparisons were made among the average perception time per line, the Thorndike test score, and the average number of lines read in thirty minute rapid reading periods. The rank-order coefficient between the reading on the Thorndike test and perception time per line was .64±.10. The correlation by the same method between the average perception time per line and the average number of lines read was .16±.17. This apparent discrepancy was explained on the basis of the nature and difficulty of the material read in the two cases. The rank-order coefficient between the Thorndike test score and the average number of lines read was .24±.14.[3]

Sixty students in general psychology were used as subjects by Garrison (**8**) in an investigation of some simple speed activities. Each of the students was given the Otis Self-Administering Test of Mental Ability. Eight different tests of speed were employed, two of which were speed of vocal responses in reading such materials as objects, colors, letters, forms, numbers, and words in a continuous, *i.e.*, all of one type of material placed together, and in a mixed order. The correlations of these two forms with the Otis were .28±.08 and .18±.09, respectively. One other of the eight tests was card sorting which correlated —.02 with the Otis. The remaining coefficients were likewise quite insignificant.

Kennedy (**14**) combined scores on the Otis Self-Administering Test, Advanced Examination, and the Terman Group Test of Mental Ability as a criterion of intelligence. A Dunlap chronoscope was used to procure the reaction times of thirty-two students at Harvard. The reliability coefficient was .91. A negative correlation of —.32 was found between reaction time and intelligence. A speed rating derived from a combination of seven tests resulted in an r=.14 with intelligence.

McFarland (**17**) administered ten different tests to thirty-four Harvard students in order "to study the inter-relationship of ability in respect to speed in different mental tasks varying in degree of complexity from simple auditory reaction to insight problems."

[3] Calculated by the reviewer.

The inter-correlations which tended to conform to an hierarchical arrangement, ranged from .00 to .88 with an average of about .60. From these results it was concluded that subjects maintain their relative speed rankings in various kinds of mental reactions; therefore, ability in respect to speed is an individual trait which is characteristic of mental behavior. It should be noted that McFarland's study did not deal with the relative importance of speed in mental ability. Rather, it observed a tendency for *some* degree of speed to be consistently present among various mental tasks from which power had been eliminated. By the application of Spearman's method of hierarchical arrangement and tetrad differences McFarland showed that the speed measures of the thirty-four subjects involved general ability. In this connection Kelley (13) has pointed out that "If one assumes one single factor to be adequate in the explanation of a given set of inter-correlations, obviously the smaller the population the more likely are the data to be consistent with the assumption." In this paper McFarland again stressed the timing of each individual test item in order to rule out "possible distraction, fluctuation of attention, or what-not entering into the lapse of time." However, Farnsworth, Seashore, and Tinker (7) have shown that neither standard time scores (time-limit method) nor scores obtained from items individually timed (work-limit method) on the Otis Advanced Examination, Form A, correlate significantly with simple reaction time. Likewise, either method of scoring gives low positive correlations with serial reaction time. Subsequently, Paterson and Tinker (19) directly compared the two methods of scoring with a speed of reading test. They reported a correlation coefficient of 1.00 (corrected for attenuation) between the scores of the work-limit and the time-limit methods. More recently, Tinker (24) declared that "one may safely assume that either method of test application will yield scores equivalent to scores obtained by the other method."

(c) Speed of Nervous Conduction

A field recently opened for investigation is that of reflex conduction rate in its relation to intelligence. The first paper by Travis and Hunter (27) is omitted from this review because the results conflict with all subsequent reports.

Rounds (22) measured the latent time of the Achilles reflex of eighty men. The scores ranged from 32 to 96 sigma. This reflex latent time, according to Rounds, is the product of an unlearned reaction, and exhibits what may be called pure "speed." This was

compared with speed scores on different tests of mental reactions such as addition, completion, letter-cross-out, figure-cross-out, and association. The correlation coefficients ranged between .21 and .51. A composite score of all the tests mentioned above with the exception of association, correlated .60 with latent time. Unfortunately, reliability coefficients of the various measures were not reported; consequently, definite conclusions cannot be drawn.

Travis and Dorsey (28) used the action current technique to test the reflex conduction rate of two groups of children whose intellectual levels were mid-imbecile and below. The first group contained fifty-seven cases with an age range from four to fourteen years. The second group of twenty-nine subjects varied from seven to ten years. The mean reflex time of these two groups were compared with the mean reflex time of forty-seven superior children, whose ages were from seven to ten. The ratio of the standing height and reflex time was used also as a means for group comparison. The results demonstrated no significant differences between the reflex times of the intellectually inferior groups and those of the superior group.

Whitehorn, Lundholm, and Gardner (31) measured the speed of the patellar reflex of thirteen defectives and compared the scores with similar measures which were obtained from thirteen normal subjects. Mental ages were assigned on the basis of Army Alpha scores. The writers observed no tendency for low mental ages to be associated with slow reflex times. The coefficient of correlation between mental age and knee-jerk reflex time corrected for various heights of the twenty-six subjects was $.15 \pm .13$.

Travis and Young (29) extended the study of the relation between electromyographically measured reflex response latency and intelligence. The correlation coefficient between the Achilles and the patellar reflex times for one hundred eleven cases was $.79 \pm .04$. Reliabilities of the two reflexes were .90 and .80, respectively. Five correlation coefficients between reflex times and measures of intelligence ranged from —.08 to .24. These coefficients were computed from the records of two hundred fifty individuals whose ages ranged between four and thirty-five years.

(d) Summary

If the correlation coefficients which involved intelligence test score as one variable are grouped from the foregoing review, the following results obtain:

(1) Fourteen correlations with simple and discriminative reaction; range of coefficients, —.32 to .90; median coefficient .16.
(2) Fourteen correlations with serial reaction; range, —.03 to .53; median coefficient .18.
(3) Five correlations with speed of reading; range, .14 to .32; median .30.
(4) Six correlations with speed in serial-verbal tasks, *e.g.*, sentence completion; range —.06 to .23; median .12.
(5) Six correlations with reflex response latency; range —.08 to 24; median .06.

If the median coefficients in the above array are representative, it can be shown by squaring r (30) that the above-listed speed measures on the average contribute a small percentage of the factors which comprise an intelligence test score. By correcting for unreliability of the measures, the percentage of common factors between speed and intelligence test score would increase somewhat. On the other hand, however, as Clark (5) has shown, it is very probable that some scores which are supposed to represent only speed are contaminated with other factors which tend to raise the correlation.[4]

[4] *Three Recent Studies:* Since the original formulation of this review, relevant articles by Claparède and his students (32), and by Freeman (33, 34), have appeared. Claparède presented an extensive summary of the experiments which dealt with the general significance of speed of response. His own study with 77 boys and girls revealed a low correlation between speed and quality of performance.

Freeman investigated the importance of speed in intelligence tests. He administered the National Intelligence Test (Scale A, Form 1), the Otis Advanced Examination (Form A), the Dearborn Group Test, the Terman Group Test of Mental Ability, and the Ohio State University Psychological Test. Each of the tests initially was given with standard limits of time, and subsequently with doubled limits of time, except the Ohio State Examination, which was repeated with unlimited time. With the extended limits of time each subject was able to attempt every item in the respective tests. The test (standard time)—retest (extended time) correlations were as follows: National .83, $N = 56$, Otis .58, $N = 51$, Dearborn .88, $N = 100$, Terman .93, $N = 42$, and the Ohio State .72, $N = 117$. Freeman pointed out that "if there is a low correlation we may conclude that the test with its original time limit measures speed for the most part, inasmuch as it appears that the slow, plodding, accurate individual is able to score much higher if he is given sufficient time to undertake the solution of each problem." Inasmuch as the above correlations were not low, Freeman concluded that the tests were measures chiefly of power, while the factor of speed was of relatively little importance. Possible exceptions to this, as he pointed out, were the Ohio State Test, and to a greater degree the Otis Advanced Examination in which the factor of speed was of fair importance.

BIBLIOGRAPHY

1. BAGLEY, W. C., On the Correlation of Mental and Motor Ability in School Children. *Amer. J. Psychol.*, 1901, **12**, 193–205.
2. BECK, L. F., Effects of Music upon Comprehension and Rate of Reading. Unpublished study completed in the Psychological Laboratories of the University of Oregon, 1930.
3. ———, Relation of Speed of Reaction to Intelligence. *Amer. J. Psychol.*, 1932, **44**, 793–795.
4. CAMPBELL, M. A., Individual Differences in the Speed of Serial Reaction of Large Muscle Groups. M.A. thesis deposited in the library of the University of Oregon, 1930.
5. CLARK, J. R., The Relation of Speed, Range and Level to Scores on Intelligence Tests. Ph.D. thesis, Dept. Philosophy, Columbia Univ., 1925. Deposited in Columbia University Library.
6. DOWD, C. E., A Study of the Consistency of Rate of Work. *Arch. Psychol.*, 1926, **14**, No. 84. Pp. 33.
7. FARNSWORTH, P. R., SEASHORE, R. H., and TINKER, M. A., Speed in Simple and Serial Reaction as Related to Performance in Certain "Intelligence" Tests. *Ped. Sem.*, 1927, **34**, 537–551.
8. GARRISON, K. C., An Investigation of Some Simple Speed Activities. *J. Appl. Psychol.*, 1929, **13**, 167–172.
9. GATES, A. I., An Experimental and Statistical Study of Reading and Reading Tests. *J. Educ. Psychol.*, 1921, **12**, 303–314, 378–391, 445–464.
10. GILBERT, E. C., The Constancy of the Speed Factor in the Performance of Various Tasks. Thesis submitted for distinction, Harvard Univ., 1926. Deposited Widener Library, Harvard University.
11. HANSEN, C. F., Serial Action as a Basic Measure of Motor Capacity. *Psychol. Monog.*, 1922, **31**, 320–382.
12. HUNSICKER, L. M., A Study of the Relationship Between Rate and Ability. *Columbia Univ. Contr. Educ.*, 1924, No. 185. Pp. 51.
13. KELLEY, T. L., *Crossroads in the Mind of Man.* Stanford Univ. Press, 1928. Pp. 238.
14. KENNEDY, M., Speed as a Personality Trait. *J. Soc. Psychol.*, 1930, **1**, 286–299.
15. LEMMON, V. W., The Relation of Reaction Time to Measures of Intelligence, Memory, and Learning. *Arch. Psychol.*, 1927, **15**, No. 94. Pp. 38.
16. MCFARLAND, R. A., The Rôle of Speed in Mental Ability. *Psychol. Bull.*, 1928, **25**, 595–612.
17. ———, An Experimental Study of the Relationship Between Speed and Mental Ability. *J. Gen. Psychol.*, 1930, **3**, 67–97.
18. MILES, W. R., and BELL, H. M., Eye-Movement Records in the Investigation of Study Habits. *J. Exper. Psychol.*, 1929, **12**, 450–458.
19. PATERSON, D. G., and TINKER, M. A., Time-Limit vs. Work-Limit Methods. *Amer. J. Psychol.*, 1930, **42**, 101–104.
20. PEAK, H., and BORING, E. G., The Factor of Speed in Intelligence. *J. Exper. Psychol.*, 1926, **9**, 71–94.
21. PERRIN, F. A. C., An Experimental Study of Motor Ability. *J. Exper. Psychol.*, 1921, **4**, 24–57.

22. ROUNDS, G. H., Is the Latent Time in the Achilles Tendon Reflex a Criterion of Speed in Mental Reactions? *Arch. Psychol.*, 1928, **15**, No. 95. Pp. 91.
23. SEASHORE, R. H., Individual Differences in Motor Skills. *J. Gen. Psychol.*, 1930, **3**, 38–66.
24. TINKER, M. A., The Significance of Speed in Test Response. *Psychol. Rev.*, 1931, **38**, 450–454.
25. THORNDIKE, E. L., *Mental and Social Measurements.* New York: Teach. Coll. Bur. Publs., 1913.
26. ———, *The Measurement of Intelligence.* New York: Teach. Coll. Bur. Publs., 1926.
27. TRAVIS, L. E., and HUNTER, T. A. The Relation Between "Intelligence" and Reflex Conduction Rate. *J. Exper. Psychol.*, 1928, **11**, 342–353.
28. TRAVIS, L. E., and DORSEY, J. M., The Relationship of "Intelligence" and Reflex Conduction Rate as Found in Hypophrenic Children. *J. Exper. Psychol.*, 1930, **13**, 370–372.
29. TRAVIS, L. E., and YOUNG, C. W., The Relation of Electromyographically Measured Reflex Times in the Patellar and Achilles Reflexes to Certain Physical Measurements and to Intelligence. *J. Gen. Psychol.*, 1930, **3**, 374–400.
30. TRYON, R. C., The Interpretation of the Correlation Coefficient. *Psychol. Rev.*, 1929, **36**, 419–445.
31. WHITEHORN, J. C., LUNDHOLM, H., and GARDNER, G. E., Concerning the Alleged Correlation of Intelligence with Knee-Jerk Reflex Time. *J. Exper. Psychol.*, 1930, **13**, 293–295.
32. COURTHIAL, A., VAN DE STADT, I., and CLAPARÈDE, E., Rapidité et qualité. *Arch. de psychol.*, 1932, **23**, 193–229.
33. FREEMAN, F. S., The Factors of Speed and Power in Tests of Intelligence. *J. Exper. Psychol.*, 1931, **14**, 83–90.
34. ———, The Factor of Speed. *J. Gen. Psychol.*, 1932, **6**, 462–468.

CONCERNING TITLING OF SCIENTIFIC PUBLICATIONS

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A writer naturally wishes to have his publications read by as many individuals as possible. However, with the mass of printed material at the reader's disposal it is entirely impossible to read all published articles. While abstracts and reviews assist in calling to our attention contributions on topics in which we are interested, such service is not complete, and there is a lapse of time between publication and later review. The final determination of whether or not an article will be read lies in the writing itself, and accordingly may be controlled by the author.

Proper titling may determine whether or not such publication is widely read or passed over. How, then, may the title be designed to advertise thoroughly the contents of the manuscript?

If we adopt the chief functions of an advertisement from Starch, we find the following: Attention, Interest, Conviction, Memory, and Action. In our case the *Attention* value may usually be ignored. Individuals interested enough to peruse our scientific journals need no further subtle arousing of attention by catch phrases or startling statements. Not only is such procedure unnecessary, but many feel that it opposes the true conservatism of science. However, it might be remarked that a monograph entitled "The Psychology of Efficiency" is said to have circulated several times as widely as it might have with an equally accurate name, but one which would sound less general and immediately applicable, such as "An Experiment in Trial and Error Learning." The recent South Pole Expedition, while organized and conducted on a thoroughly scientific basis, is being conveyed to the reading public through books with very "catchy" titles. However, this involves use out of scientific fields. Ordinarily we can assume that the psychologist will look over a recent journal and make note of articles in which he is interested.

Where does *Interest* lie? We can ignore the emotional side, so important in advertising, and consider the more intellectual. A psychologist's interest in an article will lie in three directions. (1) Topic: insight, learning, forgetting, emotion; and the sub-

divisions of these, such as retroactive inhibition, thalamic activity in fear, abstract reasoning in primates, etc. (2) Subject: human, animal, feebleminded, race, child, aged. A child psychologist, for example, may be interested in anything which pertains to individuals of a certain age, regardless of what field of behavior is being treated. (3) Apparatus. We may study a topic, say learning, by means of a maze, with discrimination devices, by the conditioned reflex method, in a problem box apparatus, or through insight situations. Yet one may be interested in the maze (or any other of these pieces of apparatus) as a psychological measuring instrument, regardless of whether human adults, children, or any special species of animal are being tested, or whether a law of learning or a physiological problem is under investigation.

Since an article may be of interest to these three classes of readers, I suggest making the title appeal to all, by including in it the problem studied, the subjects employed, and the apparatus used. As examples, three titles have been selected, these satisfying respectively one, two, and three objectives:

1. "Further Studies in Overlearning."
2. "The Retention and Recognition of Patterns in Maze Learning."
3. "Analysis of Methods in Human Maze Learning."

The first indicates only the problem; apparatus and type of subject are omitted. The second title tells of the problem and the apparatus by which it was studied, but leaves us in ignorance as to the type of subjects. The third names the problem, the subjects, and the apparatus, yet is not excessively lengthy.

Certain other titles have special features which deserve being pointed out. "The Comparative Learning of Rats on Elevated and Alley Mazes of the Same Pattern" tells very explicitly the apparatus and type of subject, and we are led to infer that the comparison is general, involving observations on various items of behavior, rather than dealing with a limited topic. Reading the article discloses this supposition to be true, so the title is justified.

It is unfortunate in many cases that the various topics dealt with can not be mentioned, as some of especial interest might be passed over by the reader who is too busy to search for material by more than title. Retention, for example, is frequently tested as a subordinate problem in connection with research on some learning topic. A similar omission, which is also entirely unavoidable, lies in being unable to name each of a number of tests, say in a motor battery, so

that anyone interested in one or more of these tests could give that part of the report special attention. A few carefully chosen words as part of the title might suggest possibilities, when it is out of the question to mention all. "A Report on the Administration of Scholastic Aptitude Tests to 34,000 High School Seniors in Wisconsin in 1929 and 1930" leaves nothing to be desired in the way of completeness, but is somewhat cumbersome for copying and reference purposes.

The problem can not be outlined so easily with theoretical articles, because the chief emphasis is on the topic. Rarely is the discussion confined to experimental results or theoretical deductions based on one type of apparatus or one class of subjects. But one may hint in his title the direction which the discussion may take: criticism, verification, addition, amplification, terminological, or systematic discussion.

1. "A Response Interpretation of Consciousness."
2. "A Behavioristic Interpretation of Consciousness."

Both of these not only show the topic, but the writer's viewpoint.

3. "Errors in Recent Critiques of Gestalt Psychology."
4. "Some Weaknesses in the Explanation of Habit Fixation as Conditioning."

These show respectively defense and criticism.

5. "Is the Refractory Phase Theory Adequate to Explain Mental Fatigue?"

By this question we see that this theory is being subjected to scrutiny, and we infer that the answer will be at least a partial negative.

6. "The Laws of Association."

This title is very general, as the article itself proves to be, and consequently tells one little of what he may expect. Being rather swamped by unread journals and books, I might have passed over this excellent article but for the reputation of its writer, Professor Harvey Carr. However, it was the author's name rather than the title which saved it from omission. Just how to improve this title, and still confine it to reasonable length, is, by nature of the contents, rather difficult to suggest; undoubtedly Professor Carr thought of this before he compromised on the short and indefinite heading. "Are Our Present Laws of Association Sufficient to Account for All Cases of Learning?" is not free from objection, but gives a somewhat better suggestion of the contents.

The discussion in the last paragraph shows some of the difficulties in the way of properly and completely titling a theoretical article. In cases where it can not be done adequately, I would suggest the author take special pains to point out the important aspects of his subsequent treatment in his first paragraph or introductory section.

This discussion has all centered around the second necessity of successful advertising: Arousing Interest. The remaining three points find little application in the title, so we may dismiss them briefly.

Conviction would come more from the author's name and from the contents than from the title. A conservative title should help to lend a modest air, but inspection of the journals shows that worry on this score is unnecessary. *Memory* will usually have to result from the thoughts imparted in the body of the article, although a title incorporating unusual words, such as "Obliviscence and Reminiscence" may have exceptional memorial value. *Action,* in this case reading, rather than purchase as in advertising, will follow through successfully arranging the title so as to hit the interests of possible readers through the three approaches mentioned above: topic, subject, and apparatus.

NOTES AND NEWS

THE Midwestern Psychological Association will hold its eighth annual meeting as guests of the Department of Psychology, Iowa State College, Ames, Ia., May 19 and 20, 1933, under the presidency of Dr. H. B. English, Ohio State University.

THE annual convention of the Association for Childhood Education will meet in Denver, June 27 to July 1, 1933. The five-day program will be headed by educators of national and international prominence. Among those expected are Julia Wade Abbott, president of the Association, and member of the White House Conference on Child Health and Protection; Josephine C. Foster, of Minneapolis, vice-president; Patty Smith Hill, Teachers College, Columbia University; Marjorie Hardy, author of textbooks on children's reading; Mary Dabney Davis, Bureau of Education, Washington, D. C.; Rowna Hanson, editor of *Childhood Education;* Lois Hayden Meek; Arnold Gesell, director of clinic of child development at Yale University; Mary Bell Fowler, of Cornell University; Helen M. Reynolds, director of kindergarten and primary grades, Seattle Public Schools.

DURING the summer of 1933 the University of Kentucky is again coöperating with the Psychological Institute of the University of Vienna in offering summer courses in psychology. These courses will be given by members of the faculty of that institute and credit will be granted by the University of Kentucky. The work is organized and under the supervision of Dr. Henry Beaumont, who is also in charge of the special tour arranged for those planning to attend this summer session.

THE following note is taken from *Science:* The committee of the American Psychological Association on Precautions in Animal Experimentation, consisting of Drs. C. P. Stone, E. G. Wever and C. J. Warden, *Chairman,* desires to call attention to the following bills which have been introduced since January first to limit experimental work on animals: (1) New York Assembly, A. 63, proposing to prohibit any experimental work upon a living dog; (2) New York Assembly, A. 181, proposing to make it a misdemeanor to experiment or operate on a live dog for any purpose other than to heal or cure the animal; (3) Massachusetts Senate, S. 113, proposing to penalize certain experiments and operations on live dogs, and (4) Maine House, H. 217, proposing a fine for the practice of vivisection in schools supported wholly or in part by the state. Dr. Warden writes: "It is hoped that members of the American Psychological Association, residing in these states, will write letters of protest against the passage of these measures to the appropriate legislators. Bills of this kind are backed by powerful organizations whose efforts to obstruct scientific research must be met by active and determined resistance."

BOOKS RECEIVED

PETERMANN, BRUNO, *The Gestalt Theory and the Problem of Configuration.* New York: Harcourt, Brace and Company, 1932. Pp. xi+344.

BLUMENFELD, WALTER, *Sinn und Unsinn.* München: Verlag von Ernst Reinhardt, 1933. Pp. 110.

VALENTINE, WILLARD L., *A Psychology Laboratory Manual.* New York: Prentice-Hall, Inc., 1932. Pp. vi+285.

BURRIDGE, W., *A New Physiology of Sensation.* London: Oxford University Press, 1932. Pp. 70.

EMBREE, EDWIN R., *Prospecting for Heaven.* New York: The Viking Press, 1932. Pp. 185.

EGAN, EULA PEARL, *The Effect of Fore-Exercises on Test Reliability.* Nashville: George Peabody College for Teachers, 1932. Pp. 37.

KALLEN, HORACE M., *College Prolongs Infancy.* New York: The John Day Co., 1932. Pp. 28.

NUNBERG, HERMANN, *Allgemeine Neurosenlehre auf psychoanalytischer Grundlage.* Berlin: Hans Huber, 1932. Pp. viii+339.

KRUEGER, FELIX, and SANDER, FRIEDRICH, *Gestalt und Sinn.* München: C. H. Beck'sche Verlagsbuchhandlung, 1932. Pp. 93.

SCHJELDERUP, HARALD, and SCHJELDERUP, KRISTIAN, *Über drei Haupttypen der religiösen Erlebnisformen und ihre psychologische Grundlage.* Berlin: Walter de Gruyter & Co., 1932. Pp. 108.

GRAEWE, HERBERT, *Untersuchung der Entwicklung des Zeichnens.* Germany: Pädagogischer Verlag von Hermann Schroedel, 1932. Pp. 180.

EMERSON, HAVEN, Editor, *Alcohol and Man.* New York: The Macmillan Company, 1932. Pp. xi+451.

BOUTS, PAUL, and BOUTS, CAMILLE, *La Psychognomie. Lecture Méthodique et Pratique Du Caractère et Des Aptitudes.* Paris: Librairie Félix Alcan, 1932. Pp. xv+131.

METFESSEL, MILTON, *Student's Guide for Demonstrations of Psychological Experiments.* New York: McGraw-Hill Book Company, 1932. Pp. xi+175.

DEUTSCH, HELENE, DR., *Psycho-Analysis of the Neuroses.* London: The Hogarth Press, 1932. Pp. 237.

ACHILLE-DELMAS, DR. F., *Psychologie Pathologique du Suicide.* Paris: Librairie Félix Alcan, 1932. Pp. xi+237.

MORROW, PAUL REED, and MISHOFF, WILLARD ORAL, *A Guide to Thesis Writing.* Georgia: McGregor Company, 1932. Pp. iv+16.